Town of Guilford
Community Coastal Resilience Plan

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Prepared for

Town of Guilford
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Executive Summary

Coastal resilience is the ability to resist, absorb, recover from, and adapt to coastal hazards such as daily inundation caused by sea level rise, increased flooding, and more frequent and intense storm surges. The residents of Guilford recognized the risks associated with occupying coastal areas prior to Tropical Storm Irene and storm Sandy, but these recent events have underscored the fact that property owners and the town bear a heavy financial burden to recover from these types of events. The Town of Guilford has developed this **COMMUNITY COASTAL RESILIENCE PLAN** as a toolbox to build coastal resilience in the coming years. The RISK AND VULNERABILITY ASSESSMENT REPORT (September 2012), REPORT OF OPTIONS TO INCREASE COASTAL RESILIENCE (February 2013), and this plan together represent a framework for the town to become resilient. As time passes and our collective understanding of sea level rise is refined, Guilford will update this plan to more appropriately reflect the town's evolving approaches to building resilience.

The overall goal of the "coastal resilience program" undertaken by the Town of Guilford is to address the current and future social, economic and ecological resilience of the town's shoreline to the impacts of sea level rise and anticipated increases in the frequency and severity of storm surge, coastal flooding, and erosion. The four basic steps of the coastal resilience program that resulted in the three companion reports were:

1. Generate awareness of coastal risks;
2. Assess coastal risks and opportunities;
3. Identify options or choices for addressing priority risks and vulnerabilities; and
4. Develop and implement an action plan to put selected options or choices into place.

The Town has previously drafted the RISK AND VULNERABILITY ASSESSMENT REPORT (step number 2) and a REPORT OF OPTIONS TO INCREASE COASTAL RESILIENCE (step number 3). These reports were funded through a grant from NOAA as part of the New England Municipal Resilience Initiative. Preparation of this COMMUNITY COASTAL RESILIENCE PLAN was likewise partially funded through a grant from NOAA as part of the New England Municipal Resilience Initiative.

In the context of hazards, **risk** is the product or the sum of **vulnerability** and **frequency**. In the context of coastal hazards, risk will change over time because the frequency will increase. Coastal storms are believed to be increasing in frequency, and flooding will increase in frequency as sea level rises. Thus, even if coastal vulnerabilities in Guilford remain static, risks will increase. However, vulnerabilities may also increase because the intensity of storm events may increase.

Guilford has a unique set of **"shared risks."** These are risks that are shared among or between different geographic areas of the town, and therefore shared among or between groups of people that may have different perspectives and priorities for coastal resilience. Shared risks present many challenges but also many opportunities for creatively reducing these risks. "Zones of Shared Risk" are regions that face common challenges either in existence already or caused by climate change A Zone of Shared Risk includes the houses, land, infrastructure, hydrological, ecological, social, and institutional elements that contribute to the functioning of a particular place.

Therefore, **Guilford is at a crossroads** with regard to reducing individual and shared risks. Vulnerabilities can remain static and risks can increase, or vulnerabilities can be reduced through adaptation to hold risks at bay. If vulnerabilities can be reduced even further, than risks could be lowered in the face of rising sea level and increased coastal storms, leading to **increased resilience**.

Many coastal resilience and adaptation strategies, measures, and actions have been described in the climate change literature since the late 1980s. Two decades ago, the primary options for adaptation that were considered viable were *protection, retreat*, and *accommodation*. However, we now understand that "accommodation" is rarely sustainable in the long term. Meanwhile, "protection" and "retreat" are overly simplified terms that do not allow for the many strategies and actions currently available to communities. Therefore consideration must be given to funding and implementing both near term and long term measures.

The town of Guilford has identified adaptation strategies that are most appropriate relative to its rural-to-suburban character, and organized these preferred adaptation strategies into a number of categories that are appropriate for the geography, population, and infrastructure found in Guilford. Initially, the town will be focusing on **infrastructure** such as roads, water supply, and wastewater; coastal **real estate and buildings such** as homes and businesses; and **shoreline protection methods** such as hard structures and living shoreline. The town also plans to increase its ability to monitor sea level rise and storm damage over time, which will help inform future updates to this plan.

Guilford's coastal neighborhoods are diverse and each will be faced with a combination of vulnerabilities to sea level rise and the increased incidence and severity of coastal storms. A combination of adaptation measures will therefore be necessary in each neighborhood in order to reduce risks and increase resilience. Likewise, neighborhood-scale resilience planning will be important in Guilford. When this planning occurs, neighborhoods will be urged to evaluate individual adaptation measures and determine how comprehensive solutions can be developed and implemented for building coastal resilience.

This plan presents **two examples** for building resilience at the neighborhood scale. These examples are the Soundview Road commercial/industrial area and the Seaside Avenue residential/ municipal area. Both examples show that there may be tradeoffs and choices to make when reducing shared risks to build resilience, but taking a phased approach will help the town address the most urgent and well-understood vulnerabilities and risks in the short term while addressing remaining vulnerabilities and risks later. The two examples were presented and discussed at a community meeting on July 15, 2013 (refer to Appendix A for a copy of the presentation).

A number of steps must be taken to implement this COMMUNITY COASTAL RESILIENCE PLAN. First, the appropriate municipal agency or commission(s) must be identified or created to administer this plan. As a result of the previously adopted Hazard Mitigation Plan, the Board of Selectman has indicated that a permanent standing committee might be appropriate. This agency will then work with existing staff from Planning, Public Works, and Emergency Management to set priorities and implement the plan. Understanding that the town cannot fully fund every adaptation strategy on its own, a number of funding sources have been identified. As new sources of funding are unveiled nationwide or statewide, the town will need to determine which are appropriate for building coastal adaptation and resilience.

1.0 INTRODUCTION

1.1 Review of Vulnerability Assessment

Utilizing The Nature Conservancy's web-based Coastal Resilience Tool, the Town of Guilford has undertaken The Nature Conservancy's Coastal Resilience Program. **Coastal resilience** is the ability to resist, absorb, recover from, or adapt to coastal hazards such as sea level rise, increased flooding, and more frequent and intense storm surges. The **goal of the Coastal Resilience Program** is to address the social, economic and ecological resilience of the Town of Guilford relative to the impacts of sea level rise and anticipated increases in the frequency and severity of storm surge, coastal flooding, and erosion.

In the context of hazards, risk is the product or the sum of vulnerability and frequency. In the context of coastal hazards, risk may continue to change over time because the frequency or intensity will increase. Coastal storms are believed to be increasing in frequency, and flooding will increase in frequency as sea level rises. Thus, even if coastal vulnerabilities in Guilford remain static, risks will increase. Therefore, Guilford is at a crossroads with regard to reducing risk. Vulnerabilities can remain static and risk can increase, or vulnerabilities can be reduced to hold risk at bay. If vulnerabilities can be reduced even further, than risks could be lowered in the face of rising sea level and increased coastal storms, leading to increased resilience.

The four basic steps of the "Coastal Resilience Program" are:

1. **Generate awareness of coastal risk (already underway and largely complete);**
2. **Assess coastal risks and opportunities (complete);**
3. **Identify choices for addressing priority risks and vulnerabilities (current effort); and**
4. **Develop and implement an action plan to put selected choices into place (future effort).**

The need for controlling risk and building resilience is not a trivial matter in communities like Guilford that rely on property taxes to fund the vast majority of municipal services. The total assessed value of all properties in the coastal management district is $1.67 billion. The tax rate is computed based on 70% of the total assessed value, or $1.17 billion. The annual revenue at the current mill rate of 21.52 is $25.11 million. If only the properties in coastal flood zones are considered, the total assessed value is $1.04 billion. The tax rate is computed based on 70% of the total assessed value, or $730 million. The annual revenue at the current mill rate of 21.52 is $15.61 million. Guilford cannot afford to lose its coastal property tax base. Any loss in assessed values along the shoreline will require a shift of the tax burden to all remaining properties in Guilford, including inland properties that are not at risk from coastal hazards.

A risk and vulnerability report was completed in September 2012. Guilford faces several major categories of vulnerabilities to coastal hazards. The categories and some of the included vulnerabilities are as follows:

- Social – Residents, business community, and visitors.
- Economic – Residential Properties, commercial/industrial businesses, municipal resources, tourism, and future development.
- Infrastructure – Roads, bridges, railroads, stormwater, seawalls, tide gates, the marina, and municipal facilities.
- Utilities – Public and private water supplies, septic systems, telecommunications, and electricity.
- Emergency Services – Fire, police, medical, sheltering, evacuation/egress.
- Natural Systems – Tidal wetlands and other coastal landforms.

The relative importance of these vulnerabilities varies by location. Some notable geographic vulnerabilities are listed below:

- Branford Town Line to Island Bay – Old Quarry is already grappling with increased inundation of the main access to some 40 homes (Old Quarry Road). Sections of Route 146 are threatened.
- Island Bay to Trolley Road – Shell Beach Road and residential structures along the road are vulnerable to storm surges as well as future daily inundation. Homes located on Leetes Island are at risk of isolation. Marsh advancement is critical but may be challenging at the peripheries of Leetes Marsh, Great Harbor, and Lost Lake.
- Trolley Road to Vineyard Point – Some homes in the Trolley Road, Sachems Head, and Vineyard Point areas are vulnerable to inundation and storm surge.
- Vineyard Point to Tuttles Point – Indian Cove is increasingly vulnerable to a loss of egress at two key locations, and Tuttles Point Road is increasingly vulnerable to storm surges as well as future daily inundation.
- Tuttles Point to Guilford Point – Like Old Quarry Road, Chaffinch Island Road is already suffering from frequent flooding. Important facilities such as Brown's Boat Yard, Guilford Boat Yard, and the Guilford Yacht Club are vulnerable to inundation and storm surge.
- Guilford Point to Madison Town Line – Jacob's Beach is vulnerable to erosion whereas homes along Seaside Avenue are vulnerable to inundation and storm surges. The Town marina and the state's East River Boat Launch are critical facilities that are highly vulnerable given their waterfront locations.
- Guilford Center and Town Center South – Several important economic areas are vulnerable such as commercial plazas along the Boston Post Road, the Soundview Road commercial/industrial area, and the Whitfield Street corridor.
- Upper East River – Although land is vulnerable to flooding, the East River estuary is a key area of interest for identifying future zones for marsh migration.

1.2 Review of Options for Coastal Resilience

The Intergovernmental Panel On Climate Change (IPCC) published the landmark paper "Strategies for Adaptation to Sea Level Rise" in 1990. The preface states that "This report represents the first survey on a global scale of adaptive options for coastal areas in response to a possible acceleration of sea level rise and the implications of these options." This was one of the earliest reports to list the three traditional categories of adaptation "to protect human life

and Property." Three basic types of adaptation were presented in the report. The following descriptions of these three types of adaptation are taken from the report:

- Retreat involves no effort to protect the land from the sea. The coastal zone is abandoned and ecosystems shift landward. This choice can be motivated by excessive economic or environmental impacts of protection. In the extreme case, an entire area may be abandoned.

- Accommodation implies that people continue to use the land at risk but do not attempt to prevent the land from being flooded. This option includes erecting emergency flood shelters, elevating buildings on piles, converting agriculture to fish farming, or growing flood or salt tolerant crops.

- Protection involves hard structures such as sea walls and dikes, as well as soft solutions such as dunes and vegetation, to protect the land from the sea so that existing land uses can continue.

In 2010, NOAA's Office of Ocean and Coastal Resource Management published the manual "Adapting to Climate Change: A Planning Guide for State Coastal Managers." Chapter 5 is dedicated to a discussion of adaptation strategies and methods. According to the manual, NOAA's seven categories of "Climate Change Adaptation Measures" are:

- Impact Identification and Assessment
- Awareness and Assistance
- Growth and Development Management
- Loss Reduction
- Shoreline Management
- Coastal Ecosystem Management
- Water Resource Management and Protection

"Mitigation" vs. "Adaptation"

In the context of climate change science, "mitigation" refers to efforts to decrease greenhouse gas emissions whereas "adaptation" refers to efforts to adapt to the effects of climate change. However, in the context of disaster resilience, "mitigation" refers to long-term efforts to reduce the effects of disasters. Thus, elements of a community's hazard mitigation plan may be similar to elements of a community's climate adaptation plan.

Elements of *protection, retreat*, and *accommodation* are found in several of these categories and sub-categories of adaptation. For example, Growth and Development Management actions can be used to manage retreat or accommodation, whereas Shoreline Management may include methods of protection as well as removing protection. NOAA notes that these adaptation measures are organized into categories that describe their primary purpose, but in many cases, they serve multiple purposes and could fit into multiple categories (e.g., acquisition could fit under Growth and Development Management, Coastal and Marine Ecosystem Management, and Shoreline Management in addition to Loss Reduction).

The EPA publication "Rolling Easements" (Titus, 2011) provides the most current comprehensive description of rolling easements and all the adaptation measures found in this broad collection of techniques. As noted by Titus in this publication, *accommodation* is viable in many communities, but no longer considered sustainable for the long term; eventually *protection* or *retreat* will be the default. This is an important concept because communities will need to understand that there is a limit to how far into the future accommodation will be practical. Many of the recent and current trends in adaptation planning (circa 2008 to the present) appear to be taking this into account.

A review of coastal resilience and adaptation planning undertaken by Connecticut communities, by municipal and county governments in other states, and by other state governmental agencies was used in connection with Guilford's vulnerability assessment to inform the development of viable options for the town of Guilford. Table 1 lists the four categories of options that were presented in the "options report" in February 2013.

Table 1
Options for Coastal Resilience in Guilford

Categories of Options	Possible Options
Management of coastal real estate and structures	Building codes (freeboard, V zone standards in A zones)
	Acquisition of damaged properties
	Zoning overlays
	Zoning amendments
	Coastal realignments through any of the above
Shoreline protection and management of coastal and near-shore lands	Hard shoreline protection
	Living shorelines
	Buffers for flood protection
	Land acquisition for tidal marsh migration
	Land conservation for tidal marsh migration
Roadway alterations	Elevation of roadways
	Abandonment of roads
	Re-evaluation of emergency routes
	Alternate egress
Protection or replacement of water supply wells and septic systems	On-site retrofits of septic systems
	Community wastewater systems
	Extension of sewer system
	Individual water treatment systems
	Community water systems
	Extension of water mains
	Vacate properties

The options listed in Table 1 were presented to the public. A number of comments were received during the public participation component of the meeting. In general, these comments were grouped into the following four themes:

- Coastal resilience planning – and many of the solutions that are implemented – may be best accomplished at the neighborhood scale; and neighborhood planning groups may need to be organized to begin looking at appropriate solutions;
- The tax base associated with coastal properties would need to be preserved in the near term and then some of the tax base may need to be shifted in the long term;
- Education and technical assistance are needed and desired by homeowners, and education could also be accomplished in the schools;
- Comprehensive solutions will be needed such as: addressing water and wastewater at the same time in neighborhoods where these systems will struggle or fail; ensuring that roadway improvements in one location are effective because improvements are also made elsewhere in the transportation network; and working on coordinated roadway and railroad improvements.

The attractiveness of options listed in Table 1 is that they can be applied at the neighborhood scale and can be used for comprehensive solutions. Guilford's coastal neighborhoods are diverse and each will be faced with a combination of vulnerabilities to sea level rise and the increased incidence and severity of coastal storms. A combination of adaptation measures will therefore be necessary in each neighborhood in order to reduce risks and increase resilience.

1.3 Approach for Community Coastal Resilience Plan: A Collective Learning Process

Plan implementation requires acknowledging and understanding peoples' different (and at times conflicting) perspectives regarding coastal resilience. People often have different goals, interests, and even definitions of "the problem" which greatly influence their level of support. These different perspectives exist regardless of scientific and technical projections of coastal change. Worse, they are likely unclear and/or unacknowledged and thus pose substantial challenges. The ability to navigate such different points of view during plan implementation cannot be taken for granted. Accordingly, there is an opportunity to structure the plan's implementation as a collective learning process to address and overcome these challenges.

One way to do so involves advancing implementation of the plan's overall objectives with local applications that are co-created by a diverse range of participants. These participants may include key individuals, members of affected communities, specialist advisors, influential organizations, and holistic thinkers, and occur at a number of scales from clusters of housing to neighborhoods or entire regions (see "zones of shared risk" in Chapter 7 as an example.) Working at these scales with such diverse participants in this way enables the challenges described above to be represented and addressed. It also clarifies to the public that the content within this document regarding strategies for negotiating and implementing the community coastal resilience plan is not prescriptive but serves as a guiding map that will be fine-tuned by engaging with specific communities to adapt the strategies themselves to the context. Identifying the appropriate scales, procedures, and facilitation of this engagement is a critical step in the implementation process to ensure challenges are clarified and addressed.

Preliminary ideas of where this is appropriate and how to do this are discussed in Chapter 8 and Appendix E.

For the purpose of aiding municipal commissions, departments, and staff in applying the technical content of this document, the options presented in Table 1 are reorganized in Table 2 corresponding with the organization of this document.

Overlap of content in this document during implementation is expected. For example, coastal realignment simultaneously involves land use and ownership change, natural resources protection, infrastructure investment, and the development and use of new policies.

Table 2

Options for Coastal Resilience in Guilford

Categories of Options	Possible Options	Chapter 2 Protective Infrastructure	Chapter 3 Community Infrastructure	Chapter 4 Natural Resources Protection	Chapter 5 Regulatory and Other Tools	Chapter 6 Property Acquisition
Management of coastal real estate and structures	Building codes (freeboard, V zone standards in A zones)				✓	
	Acquisition of damaged properties*					✓
	Zoning overlays				✓	
	Zoning amendments				✓	
	Coastal realignments through any of the above*			✓	✓	✓
Shoreline protection and management of coastal and near-shore lands	Hard shoreline protection	✓				
	Living shorelines	✓		✓		
	Buffers for flood protection	✓		✓		
	Land acquisition for tidal marsh advancement			✓		✓
	Land conservation for tidal marsh advancement			✓		
Roadway alterations	Elevation of roadways		✓			
	Abandonment of roads		✓			
	Re-evaluation of emergency routes		✓			
	Alternate egress		✓			
Protection or replacement of water supply wells and septic systems	On-site retrofits of septic systems		✓			
	Community wastewater systems		✓			
	Extension of sewer system		✓			
	Individual water treatment systems		✓			
	Community water systems		✓			
	Extension of water mains		✓			
	Vacate properties		✓	✓		

2.0 PROTECTIVE INFRASTRUCTURE

2.1 Hard Shoreline Protection

The REPORT OF OPTIONS TO INCREASE COASTAL RESILIENCE (February 2013) indicated that planners in the United States believe that hard shoreline protection is likely to be necessary to protect 60% of the low-lying shoreline along the Atlantic coast if sea level raises three feet in the next century. Hard shoreline protection generally includes the following structures that are parallel to the shoreline:

- Seawalls that are engineered barriers that protect land from waves and flooding
- Levees that are engineered berms that protect land from flooding
- Bulkheads that are engineered structures that retain soil and reduce erosion
- Riprap which provides protection from erosion by dissipating wave energy

In addition, hard protections that are not parallel to the shoreline may include jetties, groins, revetments, and the like.

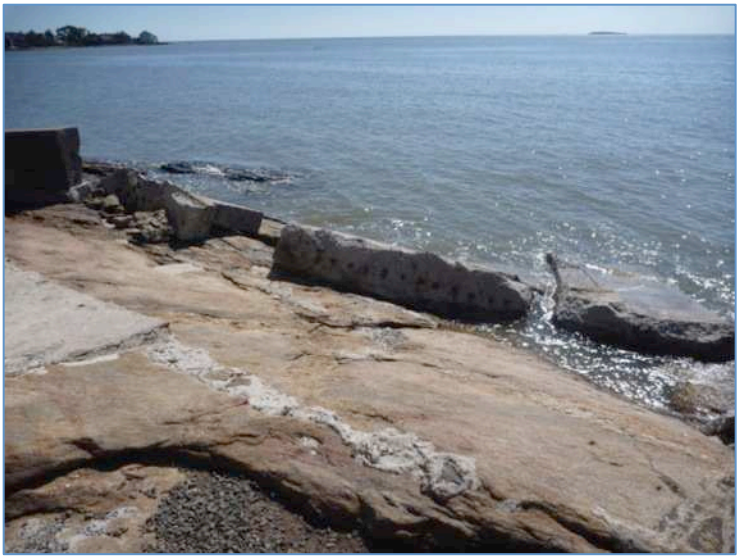
In order to embrace hard shoreline protection in a community, it is often necessary to inspect coastal structures such as bulkheads and seawalls; determine which structures are deteriorating and need repair; prioritize repair of structures based on condition and ability to protect property; and assess privately-owned coastal structures. Guilford will continue to have areas that are protected by hard shoreline protection well into the future, including private properties and municipal facilities such as the marina. Further, maintenance of existing hard structures is a desired action that is discussed in the town's Hazard Mitigation Plan and the Municipal Coastal Program. In short, hard shoreline protection will always be an important tool for Guilford to maximize coastal resilience in discrete areas.

The Town's Hazard Mitigation Plan recommended consideration of the following specific hard shoreline/structural measures:

- Continue beach nourishment at Jacob's Beach
- Extend the breakwater near Jacob's Beach
- Construction of a new groin at Grass Island
- Installation of wave attenuation structures offshore in several locations
- The use of dredged sediment for stabilizing marsh fronts such as those near Grass Island, Chittenden Beach, and Chaffinch Island
- Construction of a groin at Chaffinch Island point East of the West River Mouth
- Construction of pile-supported walkways where foot traffic is exacerbating erosion
- Maintain/upgrade existing hard structures which protect individual properties in the local associations throughout the shoreline areas.

Further the Hazard Mitigation Plan recommended that the Town conduct a study of alternatives for erosion control at Jacobs Beach, Chittenden Beach, Grass Island, and near Chaffinch Island and implement feasible and prudent alternatives.

The need to maintain and upgrade existing hard structures, which protect individual properties in the local shoreline associations, is well illustrated by the effects of both Tropical Storm Irene and Hurricane Sandy. The properties along Prospect Avenue in Sachems Head Association are a good example. Most of the individual homes in this area are protected by seawalls, which although private, are essentially continuous along the entire shoreline. The seawall is generally made of a series of monolithic cement walls. In both storms, large sections of wall failed (refer to the photograph to the right) and fell into the sea leaving the properties vulnerable to severe wave damage. The protection provided by this wall could be greatly enhanced by the installation of tiebacks and/or a rock revetment in front of the wall.



This plan recommends the continued use of hard shoreline structures in appropriate parts of Guilford, and potential use of repaired, restored, or new structures; some may be installed in connection with living shorelines, discussed below.

2.2 Living Shorelines

Living shorelines are shoreline management approaches that use natural elements, such as vegetation, to protect shorelines from erosion, provide or enhance habitat and water quality and preserve the natural processes and connections between riparian, intertidal and subaqueous areas.

There are two basic types of living shoreline that meet this definition, 1) non-structural (e.g. vegetation, fill, and coir logs) and 2) hybrid (rock structure used to support vegetation growth). Hybrid techniques incorporate non-structural approaches for erosion control in combination with more traditional approaches. In general, non-structural approaches are considered more likely to succeed in low wave energy environs, while hybrid techniques are typically applied in areas of medium to high wave energy. Generally the sites in Guilford that have been recommended for living shoreline type erosion control are areas of high wave energy. Therefore hybrid designs intended to allow the restoration and stabilization of the marshes will

require the use of structural measures. A specific example of one of the recommended projects at Chittenden Beach would include:

- Replacing the old submerged groin at the east side of the mouth of the West River
- Installation of wave attenuation structures offshore
- The use of dredged sediment for stabilizing marsh fronts such as those near Grass Island, Chittenden Beach, and Chaffinch Island
- Construction of a groin at Chaffinch Island point

The stabilization of Chittenden Beach has been recommended since the Engineering Report prepared by Decesare-Bentley for the town Harbor Management Commission in 1985. According to recent aerial photographs, Chittenden Beach on the East Side at the mouth of the West River is eroding at a rate exceeding 50 feet per decade. Valuable habitat is lost each year and the osprey nest at the point has one leg in the water. This area is Town owned and this site has great potential for fulfilling future public access needs, if the waterfront can be stabilized.

The three marinas upstream collectively dredge 25-30,000 CY of material every 2-3 years. It has been documented that much of this material is eroded from the Town-owned Chittenden Beach property by constant wave action and transported upriver on the incoming tide. Further, because of the loss of the protective headland, the piers and docks at Brown's Boatyard are increasingly at risk from southeast winds.

The restoration of this area using dredged material as the substrate for the placement of marsh plantings will require the use of physical measures including restoring the previously existing breakwater (groin) on the eastern side of the West River and establishment of a series of low stone sills to hold the dredged material in place until it consolidates and the marsh plant root systems become well established. Further, the installation of wave attenuators offshore will break up the high velocity wave pattern and protect the plants during the re-establishment. The structures will be necessary to allow the dredged material to be returned to the mouth of the river and used as a basis for marsh and beach restoration. This is a desirable beneficial use and obviates the need to deposit the material uselessly in the Long Island Sound Dumpsite. Figure 1 is on the next page is a conceptual design for these actions.

Recent changes in Connecticut's coastal management laws make the use of living shorelines more permissible along the state's shoreline by excluding them from the definitions associated with hard structures. In 2012 the Connecticut General Assembly passed Public Act 12-101, An Act Concerning the Coastal Management Act and Shoreline Flood and Erosion Control Structures. The Act combined a number of initiatives to address sea level rise and revise the regulatory procedures for shoreline protection. The Act allows DEEP to establish a pilot program to encourage "innovative and low-impact approaches to shoreline protection and adaptation to a rise in sea level. Such approaches may include living shorelines techniques utilizing a variety of structural and organic materials, including, but not limited to, tidal wetland plants, submerged aquatic vegetation, coir fiber logs, sand fill and stone to provide shoreline protection and maintain or restore coastal resources and habitat."

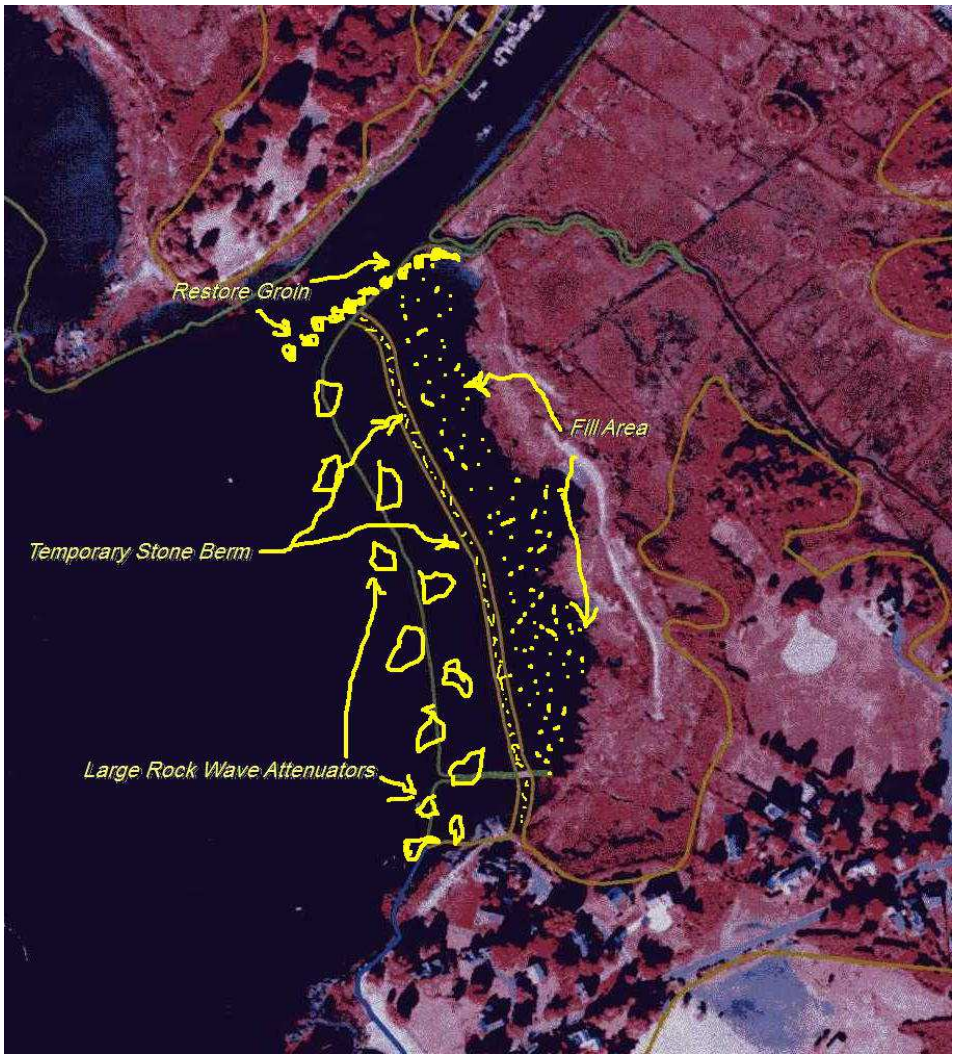


Figure 1
Conceptual Design for West River/Chittenden Park Area

This plan recommends the use of living shorelines in Guilford. The West River/Chittenden Park area should be pursued as a pilot study area.

2.3 Buffers for Flood Protection

The use of buffers in Guilford is not a new concept. The Municipal Coastal Program recommended a system of variable buffers for shoreline properties, and the Planning and Zoning Commission often requires buffers in connection with development projects. Buffers may be associated with tidal wetlands although this is not necessary.

The role of buffers relative to coastal resilience is that they provide space for flood mitigation and wave attenuation between tidal waters and structures or infrastructure. While buffers may

not stop water from reaching a structure, research of coastal storm damage in the United States has shown time and time again that storm surges are slowed and waves are attenuated when buffers are available. Furthermore, the space within a wide buffer is often most likely to be subject to daily inundation by sea level rise; if the space is left intact as a buffer rather than developed, then the effects of daily inundation on developed land can potentially be delayed.

There is another unique way in which Guilford can "armor" the shoreline with buffers: projects such as the West River/Chittenden Park restoration (hard structures and living shorelines), if successful, will provide more shorefront to protect infrastructure and properties further inland.

Setting aside buffers between water and structures or between water and infrastructure is viewed as an important tool for Guilford to increase coastal resilience. Wherever possible, the town should strive to maximize the distance between the waters of the sound and public or privately funded development or infrastructure.

This plan recommends the expanded use of buffers to facilitate storm surge and wave attenuation for increased resilience. These buffers should be created by carefully regulating development and redevelopment; and by implementing projects such as the West River/Chittenden Park study described above.

3.0 COMMUNITY INFRASTRUCTURE

3.1 Roads and Transportation

Guilford's Municipal Coastal Program and Hazard Mitigation Plan both address roads. The specific roadway vulnerabilities in Guilford were also documented in RISK AND VULNERABILITY ASSESSMENT REPORT. Roadway alterations in Guilford may include elevation of roadways, abandonment of some roads, re-analysis of emergency access, and developing alternative egress for some areas. These are described below. Route 146 is separately addressed after the descriptions.

Elevation of Roadways

Roads can be elevated to remain viable while flood elevations increase. This has been done in many coastal communities along the east coast of the United States over the last century as sea level has been rising. Elevating roads to alleviate flooding is a practical approach in addressing access to neighborhoods. The drawback to elevating roads is that private properties often remain at lower elevations and therefore remain flood-prone. A higher road surface can then impede drainage of floodwaters off properties. Cross culverts can be used to facilitate drainage under elevated roads. At significantly greater cost and effort, some roads can be elevated on piers or long bridges.

Guilford has many neighborhoods whose only access is a causeway through tidal wetlands. However, these causeways generally are not abutted by residences.

The Town is currently seeking Connecticut DEEP approvals to elevate Old Quarry Road. As part of the approval, Leetes Island Marsh will be restored (over 40 acres). DEEP is of the opinion that this extensive restoration may be sufficient mitigation for the Town to elevate the remaining causeways to the Shell Beach, Vineyard Point, Sachems Head, Indian Cove, Mulberry Point, Chaffinch Island and Tuttles Point neighborhoods.

Chaffinch Island Road provides access to two homes and a park, but also to two marinas. It is a short section to elevate and due to the businesses may be the most feasible solution.

Seaside Avenue is not a causeway and is abutted by many houses. Elevating this roadway will not alleviate the flooding of abutting homes. Improving access to these homes is not justified if the homes will still be flooded. Elevation of the roadway would need to be in conjunction with the elevation of all the homes in the neighborhood in order to achieve a viable solution.

Road elevation is not a viable solution for the Circle Beach road neighborhood. The existing road and homes are founded on shifting beach sand. The neighborhood is in a wave action zone. Structures need to be protected from wave action as well as being elevated.

The elevation of roadways can be accomplished under Guilford's Capital Improvements Program. For the FEMA mitigation funds to be utilized for elevating roads, the project must

meet the criteria of having benefit-cost ratio that exceeds 1.0 when evaluated using the FEMA benefit-cost analysis. For this to occur, a specific roadway will need to have relatively high traffic counts and long detour times. This is not likely to be the case for many of the less-populated areas, but may be viable for more heavily traveled roads.

Abandonment of Some Roads

Some communities may find it acceptable to abandon roads as the cost of elevating or maintaining a road becomes excessive. In Guilford, one potential example of a road that could be abandoned is the section of Tuttles Point Road that connects Tuttles Point to Mulberry Point. This section of road is already flood-prone. However, the road could not be abandoned unless an alternate mode of access was developed for Tuttles Point residents, such as a road further inland. At the present time, abandonment of roads is not considered feasible in Guilford because the coastal neighborhoods generally have only one access road.

Developing Alternative Egress for Some Areas

Developing alternate egress would likely be used in connection with abandonment of roads and/or re-assignment of emergency access. At the present time, only Tuttles Point, Mulberry Point and Indian Cove have possible alternate egresses. However, these egresses are not constructed. New roads would have to be built along undeveloped right-of-ways. The town currently believes that it is less costly to elevate existing traveled ways.

Re-Analysis and Evaluation of Emergency Access and Routes

Some communities may abandon designated emergency access ways (without actually abandoning the associated road) while selecting a different route for emergency access or evacuations. In Guilford, one potential example is to leave Daniel Avenue at its existing grade and elevate West Lane so that Indian Cove residents may evacuate to the west instead of to the east.

Other Types of Access

Section 7.0 of this plan ("Examples of Future Planning in Zones of Shared Risk") includes a discussion of Seaside Avenue that suggests the possibility of future scenarios that lack road access to isolated properties. For example, water access may be needed to reach some properties when certain lands currently occupied by roads have become submerged. In other cases, boardwalks may be possible to enable pedestrian access when certain lands currently occupied by roads have become submerged.

Route 146 Multi-town Corridor Study

The RISK AND VULNERABILITY ASSESSMENT REPORT identifies Connecticut Route 146 (also known as Boston Street, Water Street, and Leete's Island Road in Guilford) as a highly vulnerable infrastructure resource. Flooding from coastal storms, extreme high tides, and from projected

sea level rise occurs at numerous locations along this road, significantly impeding access to coastal neighborhoods. This flooding phenomenon, although not specifically identified in this report, also occurs in Branford between the Guilford/Branford Town line and Branford Center. This plan recommends that the Towns of Branford and Guilford join with the South Central Regional Planning Agency and the Connecticut Department of Transportation in a long range corridor study to address these issues and develop a state of the art plan for this important facility.

Two aspects of this proposed plan warrant further discussion. First the plan should be multi-jurisdictional in that the road serves two towns (Guilford and Branford), and is owned and managed by the State of Connecticut. Second, the road and its corridor are particularly unique in terms of its character and multi-dimensional function.

The planning process for this work should be guided and managed by a study committee representing the two towns, the State, the Regional Planning Agency or the Council of Governments (the regional planning agency's parent entity), and property owners and residents of the corridor. Funds should be provided by the relevant governments and consultants retained to carry out this planning project.

This planning process should address issues and opportunities associated with the corridor's special character and its many functions[1]. The specific coastal resilience issues that need to be addressed include:

- Roadway elevation
- Roadway abandonment
- Alternative access provisions
- Road widening or narrowing

In addition to addressing the resiliency issues the following issues must be addressed:

- The scenic character of the road (Route 146 is a State designated scenic road)
- The use of the road as a popular bike route
- Portions of the corridor are in a National Register Historic District
- The presence of extensive salt marshes bordering the road
- The location of Amtrak northeast corridor rail line adjacent to the road
- The use of the corridor as part of the New England Shoreline Greenway trail

[1] Reference: "Routes 77 and 146 Corridor Management Plan" 1996, prepared by the Route 77 and 146 Scenic Road Advisory committee; and the Connecticut Department of Transportation "Shoreline Greenway Trail Preliminary Engineering Study" prepared for South Central Regional Council of Governments by Stantec Consulting Services, June 30, 2010.

3.2 Water Supply

As noted in the RISK AND VULNERABILITY ASSESSMENT REPORT, some of Guilford's neighborhoods will face serious problems relative to water supply and sanitary wastewater disposal as sea level rises and groundwater rises accordingly. Adaptation methods may include on-site retrofits to septic systems, development of community water and wastewater disposal systems, extension of sewer and water systems, or – in extreme cases – vacating properties.

Individual Water Treatment Systems

As salt water intrusion allows brackish groundwater to flow into wells, residents may choose to remove dissolved solids (salt and other minerals) using small reverse osmosis treatment systems. These systems can also be used to remove nitrates that originate in nearby septic systems. Individual water treatment systems can be used for many years and are easily replaced when necessary.

Development of Community Systems

Community water systems may be feasible for some parts of Guilford. Community water systems are strictly regulated by the Connecticut Department of Public Health. Community water systems in Guilford must be owned and operated by the Connecticut Water Company, which holds the exclusive service area in Guilford. Such systems can only be developed where the appropriate sanitary setbacks (established in the Public Health Code) around each well can be placed into the control of the water company; this typically requires several acres of land for well sites. It would be difficult to site wells with the appropriate sanitary setbacks and open space near Guilford's coastal neighborhoods while maintaining a reasonably close distance to the neighborhoods in order to keep water transmission costs to a minimum. If water from new wells needs to be treated, then costs will increase.

Extension of Water System

The Connecticut Water Company already owns and operates a public water distribution system in Guilford. The system is present in areas such as Sachems Head but it does not extend into coastal neighborhoods such as Indian Cove, Mulberry Point, and Tuttles Point. The Town of Guilford commissioned a feasibility study for extending the water system to these three neighborhoods and developed cost estimates for water main extensions. Following this exercise, Guilford residents voted against extending water mains to Indian Cove, Mulberry Point, and Tuttles Point. However, the town recognizes that over the long term, this may be one of the only viable means of providing a safe and reliable water supply to coastal neighborhoods. The town should continue looking for grants to pay for the extension of the water main.

Vacating Property

In extreme situations where on-site solutions are not feasible for providing a potable water supply and community or townwide systems are not possible due to feasibility or expense, some

properties may be rendered unusable. These properties will be vacated, possibly abandoned, and the town will lose the associated tax base. However, these locations could represent an opportunity to provide parks or other passive public amenities along with greater flood protection.

The Connecticut Coastal Management regulations note that the policies concerning development, facilities, and uses within the coastal boundary are to locate and phase sewer and water lines so as to encourage concentrated development in areas which are suitable for development; and to disapprove extension of sewer and water services into developed and undeveloped beaches, barrier beaches and tidal wetlands; except that when necessary to abate existing sources of pollution, sewers may be used that will accommodate existing land uses.

3.3 Wastewater

New Construction/ Reconstruction

Sanitary systems should be constructed as far from the water and tidal marshes as possible and a minimum of 50 feet from the high tide line or edge of tidal marsh to allow for the increase in sea level rise and for marsh advancement. Current Department of Public Health regulations provide for an exception which allows septic systems to be installed up to 25 feet away from open water for lots in existence prior to August 16, 1982.

Septic systems should be constructed at elevations that consider sea level rise. If elevating the system is not possible, a second option for the septic system for lots within the predicted 2050s inundation area that meet current 'adequate treatment zone' and normal septic field testing, is that the sanitary system design plan should designate future location for a retrofit system (mound or holding tank). The required holding tanks should be designed for buoyancy conditions based on 2050s inundation depths.

On-Site Retrofits

A small number of potential solutions may be available for property owners to continue generating sanitary wastewater on their properties as sea level rises. First and foremost, septic systems can be elevated to maintain an appropriate vertical separation between effluent leach fields and the surface of the groundwater table. Elevating a system will typically require building a mound of fill material over the new system, and the use of pumping equipment because gravity drainage will no longer be possible. The elevated system may not provide adequate protection during a storm in which wave action or the retreating storm surge may cause soil around the leaching fields to be washed away. Engineered erosion control techniques may be needed to assist with reduction of the erosion.

If elevating a system is not possible, a suitable site for a new system may be found elsewhere on a property. However, the town of Guilford recognizes that this will be difficult for many of the small lots found in some of the shoreline neighborhoods where water supply wells are also present on lots. As part of building permit reviews for improvements of shoreline properties,

sanitary systems reviews should be looked at for protecting an area of the property away from the critical coastal resources that would allow for the construction of a septic system that would be elevated.

In cases where the full area needed for renovation of wastewater is no longer available, property owners could attempt to install and maintain advanced sewage treatment facilities. While this may be feasible from an engineering viewpoint, it is unlikely that the average homeowner would have the time and financial resources available to constantly maintain these treatment systems in working order.

Incinerating toilets, composting toilet or a heat-assisted composting toilet can be utilized for replacing failing subsurface sewage disposal system or lots that could not fully support a code complying elevated septic system. The wastes removed from composting toilets shall be disposed of by burial or other methods approved by the local director of health.

In cases where septic systems cannot be improved, it may be possible to install effluent holding tanks. The tanks would then be pumped out and sanitary wastewater would be delivered to a sewage treatment plant elsewhere in Connecticut. In practice, this is probably not feasible for most of Guilford's coastal neighborhoods. During the busy summer months, neighborhoods could face multiple pump outs with trucks crowding the streets in densely populated neighborhoods.

Off-Site Retrofits

For existing lots that cannot support an elevated sanitary system, the leaching fields can be installed on an adjacent property with a sanitary easement approved by both property owners and the Commissioner of Public Health. The sanitary system would require a pump chamber to move the effluent to the leaching fields.

Development of Community Systems

If the above options are not viable for a certain neighborhood, then community wastewater disposal systems may be feasible for some parts of Guilford. As sea level rise increases, sanitary systems at shoreline properties such as Seaside Avenue are predicted to be underwater at least twice a day by the 2050s. In order for these properties to dispose of their sanitary waste, a community system would need to be constructed on a parcel that would be able to handle the flow sanitary waste from the neighborhood and be in an area not subject to sea level rise and coastal storms (or at the very least, less vulnerable to coastal storms and flooding).

Community wastewater systems are currently undergoing feasibility studies in several shoreline towns in Connecticut such as Old Saybrook and Old Lyme where beach communities have struggled with septic system failures. Community systems are strictly regulated by the Connecticut Department of Energy and Environmental Protection (for flows exceeding 5,000 gallons per day [gpd]) or the Department of Public Health (for flows less than 5,000 gpd); along with the local health department. It would be difficult to site sanitary systems is some of the

shoreline neighborhoods with the appropriate sanitary setbacks to wells and coastal resources while maintaining a reasonably close distance to the neighborhoods in order to keep costs to a minimum.

Development of a community wastewater disposal system is currently being studied by the selectmen's office for the Town Center South area. The consultant that has been retained to review the project is required to evaluate the effects of sea level rise on the Pages Lane property. Additional studies would be required to study the suitability of the package treatment systems in the various shoreline neighborhoods.

Sanitary sewer systems are not presently located in Guilford's coastal neighborhoods. In order to provide sanitary sewer service in place of septic systems, the town would need to develop a new sewer system and identify a location for treating sewage. This could be a new sewage treatment plant in Guilford, or the town could pump sanitary wastewater to a nearby municipality with a treatment plant. In either case, this solution to wastewater handling in Guilford would cost many millions of dollars, if not more.

4.0 NATURAL RESOURCES PROTECTION

Guilford has a remarkable diversity and abundance of natural resources that provide habitat for wildlife and fisheries, enhance the aesthetics and quality of life for residents, and serve to buffer the coastline and riverine systems as natural defenses against hazards such as storm surge, inland flooding, and sea level rise. The presence of natural resources in Guilford – in particular beaches/dunes, salt marsh, forested headwaters, and floodplains – is the result of previous recognition and commitment to their long-term conservation and balance with economic growth. In order to maintain these natural resources it will require 1) routine and on-going management activities as well as the restoration of degraded areas, 2) forward-looking planning to accommodate changes in habitat composition and location due to climatic change and 3) enforcement, modification and/or development of new land use and development policy.

There will also be opportunities to integrate the services provided by open space and wetlands via green infrastructure projects (surface runoff storage and infiltration, wave attenuation, pollutant sorption, etc.) as related to new development, redevelopment, or realignment activities across the Town. Taken in total, the immediate and longer-term management of and for natural resources by the State, Town, private property owners, non-profit organization, and others will help to reduce coastal risks and improve resilience in Guilford.

Existing Natural Resources

To ensure that the existing natural resources in the Town remain of the highest quality and integrity, management plans and actions should focus on several factors that will reduce non-climatic impacts resulting in a more resilient resource overall. These activities should include but are not limited to active mapping and control of invasive species (i.e., *Phragmites*), routine debris removal (i.e., garbage, plastics) from flood prone areas, pursuit of additional and complementary open space acquisition/easement, identification of water quality impairments and contributing sources, and detailed assessment of hydrologic impediments (i.e., undersized culverts, tide gates, road crossings) to tidally influenced and other flood prone areas.

These activities will help to ensure that the existing natural resources in Guilford are more resilient and better able to accommodate likely changes in frequency, intensity, and duration of precipitation, heat, storms, and sea level rise.

Future Natural Resources

While longer-term changes in temperature and precipitation patterns will alter the species composition and type of habitats in a given location, the more immediate implication is the upland migration or advancement of habitats such as salt marsh as sea levels continue to rise. Sea level rise and the impacts of flooding have and will continue to alter the presence and abundance of natural resources in Guilford.

One of the most noticeable changes is occurring at the immediate edge of the shoreline where salt marsh is in the process of moving upslope with sea levels into areas now considered

uplands. In order to clearly identify where this will occur along Guilford's shoreline, The Nature Conservancy has completed a "Salt Marsh Advancement Zone Assessment" (2013). The results from The Nature Conservancy assessment are summarized herein as a further guide to planning to future locations of natural resources in Guilford.

The Nature Conservancy's report examined future extent of marsh advancement across the entire town's coastline by the 2080s as well as ownership attributes of those individual parcels with salt marsh advancement zones. The results serve to inform stakeholders and managers about future migration corridors, current land use, and which parcels in particular, are critical to secure advancement into suitable sites to ensure persistence of natural resources in Guilford longer-term. Suitable sites are classified based on the current land cover type (i.e., "forest" or "agrigrass") and as such are expected to convert to salt marsh as hydrologic conditions change due sea level rise in the absence of further land use conversion. Land cover types classified as "urban" (i.e. roads, buildings, parking lots) are considered to be unsuitable for marsh advancement at this time.

The full extent of salt marsh advancement in Guilford by the 2080s is projected to be 925 acres with 752 acres (81%) considered to be suitable advancement areas that present opportunities to improve natural defenses against hazards and overall resilience of the Town. The remaining 173 acres (19%) are currently unsuitable for advancement. Of the 752 acres, 225 acres are currently in protected open space status ("OS") while the remaining 526 acres are privately or publically owned without a protected status ("Non-OS"). Refer to Table 3 below and Figure 2 on the next page for an illustration of these figures.

Table 3
Total Suitable Salt Marsh Advancement Areas by Parcel Type in Guilford
Source: The Nature Conservancy, 2013

Total Suitable Advancement			
Parcel type	Yes	No	Total
OS	225.68	28.57	254.25
Non-OS	526.03	144.84	670.88
Total	751.71	173.41	925.12

This suggests that proactive management for salt marsh advancement on protected open space (30% of total suitable advancement areas) will need to be augmented through stakeholder outreach and engagement to encourage management of all or a portion of the 526 acres (70%) without protected status. The suitable advancement areas are distributed across approximately 1,000 parcels with a s subset of just 28 parcels (34% of the total area) holding greater than 5 acres each of suitable advancement area. Refer to Figure 3 on the next page.

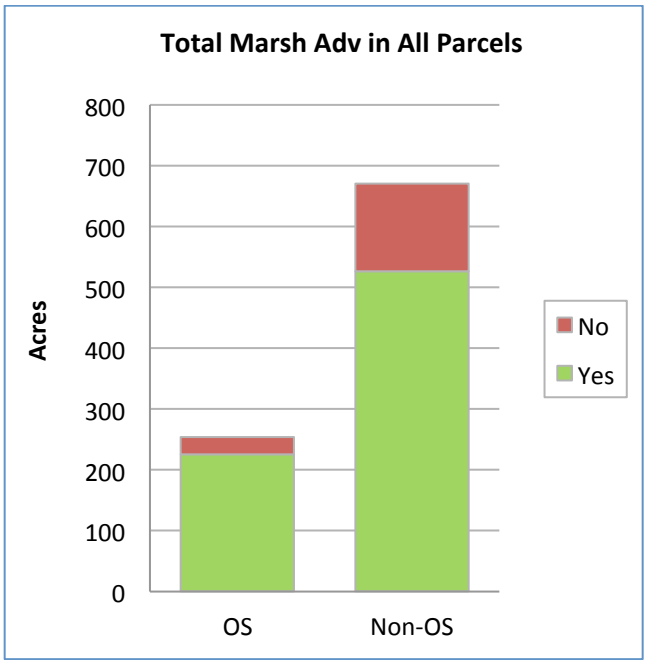


Figure 2
Total Suitable Salt Marsh Advancement Areas by Parcel Type ("OS" – open space; "Non-OS" – non-open space status) in Guilford
Source: The Nature Conservancy, 2013

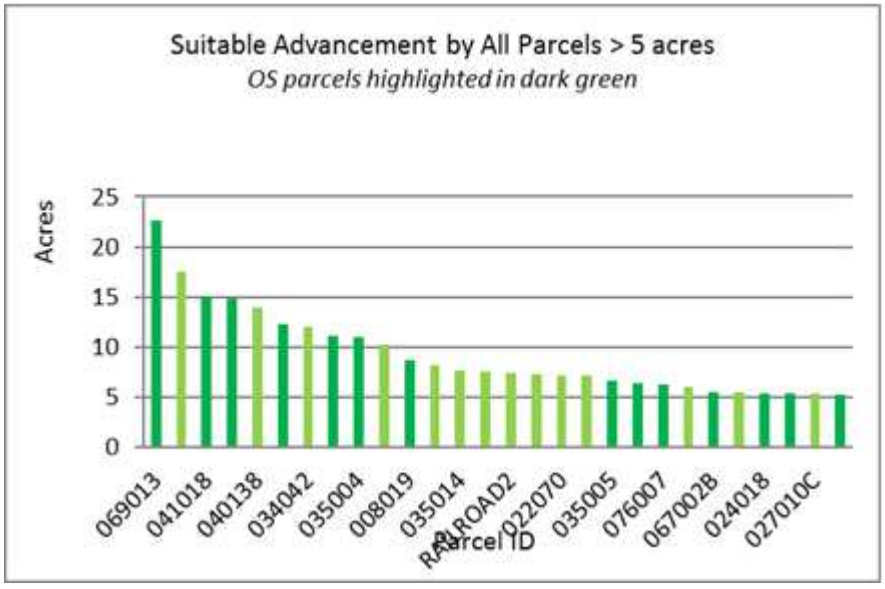


Figure 3
Suitable Salt Marsh Advancement Areas by all Parcel Types ("OS" – open space; "Non-OS" – non-open space status) with greater than 5 acres in Guilford
Source: The Nature Conservancy, 2013

Existing protected open space in Guilford consists of state or municipal parks, conservation easements on private property, or simply properties owned by land trusts. The unifying characteristic of these properties, and what makes them a critical component of long-term resilience, is that they currently have little to no development and are the most likely areas to remain undeveloped through the 2080s. The recognition of their role in future wetland extent and improved resilience in Guilford is vital information for land management, economic development, and planning. With reference to Figure 4 and Table 4, parcels currently listed as protected open space represent 254 acres of advancement with 226 acres of suitable advancement sites for future wetlands. This represents 24% of the overall total of 925 acres of advancement areas in Guilford.

Table 4
Suitable Salt Marsh Advancement Areas in Open Space and Non-Open Space Parcels in Guilford
Source: The Nature Conservancy, 2013

Open Space Marsh Advancement		
OS type	Acres	Percent (%)
Yes OS	225.68	24.39
No OS	28.57	3.09
Non-OS	670.88	72.52
Total	925.12	100.00

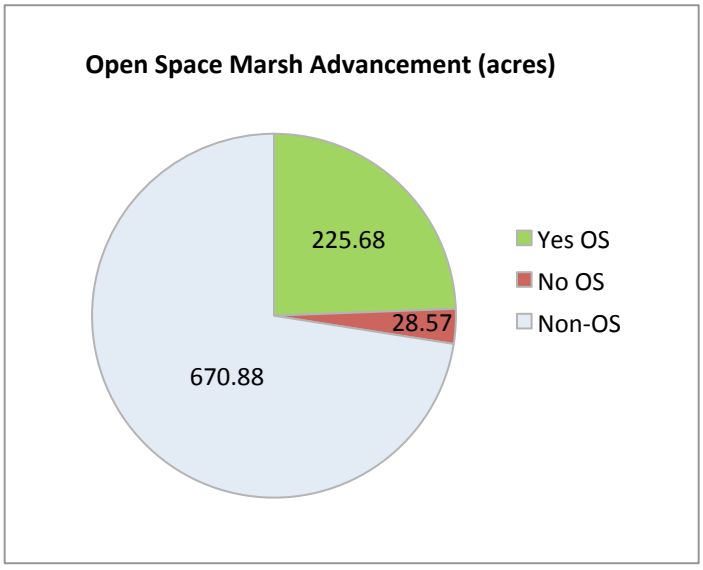


Figure 4
Suitable Salt Marsh Advancement Areas in Open Space and Non-Open Space Parcels in Guilford
Source: The Nature Conservancy, 2013

Land trust organizations such as the Audubon Society of Connecticut and the Guilford Land Conservation Trust are the largest owners of suitable marsh advancement areas, accounting for 89 acres, or 39% of the protected open space, total (Table 5). Yet, this amount represents only 10% of the overall suitable advancement area in Guilford. The Town itself is the next largest owner of suitable advancement area with 59 acres, which accounts for 26% of the total and 6% of the overall total. State-owned property and private interests, such as Yale, cemeteries, or individuals, are not far behind with 45 and 33 acres, respectively.

Table 5
Suitable Salt Marsh Advancement Areas in
Open Space Parcels by Owner Type in Guilford
Source: The Nature Conservancy, 2013

Suitable Marsh Adv in OS Parcels			
Owner type	Acres	% of total "yes" OS	% of total "yes" adv
Land Trust	88.55	39.24	9.57
Town	59.20	26.23	6.40
State	44.56	19.75	4.82
Private	33.36	14.78	3.61
Total	225.68	100.00	24.39

Natural Resources: Land Use and Development Policy/Regulations

As discussed above there are several approaches to ensuring that natural resources persist in Guilford and continue to provide natural defenses against the increasing threat of hazards. These include the on-going protection of existing natural resources through enforcement for sensitive resource (wetlands principally) against encroachment from existing or future development. Current regulations are designed to accommodate this community need however, as certain habitat types respond to changes in flooding frequency and sea level rise, this will require further regulatory consideration. This may require increasing current setbacks on private and public property to accommodate suitable advancement areas to prevent further impacts to health, safety and structures.

Another approach is to re-examine existing zoning across the Town and consider rezoning current locations subjected to repetitive flooding “high hazard zones” with additional restrictions on density, modifications, and location of suitable advancement areas. These types of land use/zoning applications would help to limit exposure to citizens of Guilford and improve opportunities for existing and future natural resources.

In complement to these approaches, the Town should consider incentivizing these proactive measures by providing limited property tax relief for private property owners that enable

suitable advancement areas. This could serve as a cost effective means of reducing the additive exposure and services required for new or expansion of existing development in high hazard areas.

These types of approaches are predicated on the recognition and formal adoption of suitable advancement locations at the parcel scale and obligations for the Town and State to refer to during appropriate review processes. It is also conceivable that the review process could be incentivized to reward new or expansion of existing development that factor in risk reduction measures such as suitable advancement areas and additional green infrastructure approaches. Mitigation "credits" for setting aside suitable advancement areas as well as restoring natural resources as structures are repositioned in a buildable lot are just a few examples to consider. Taken in total there are many creative policy and regulatory steps that can be advanced to ensure both the existing and future natural resources in Guilford continue to be of service as natural defenses, to support this community's character and quality of life, and provide critical habitat for fish and wildlife.

5.0 REGULATORY AND OTHER TOOLS

A comprehensive program of regulatory changes is proposed in order to promote coastal resiliency consistent with the principles of this plan. The Coastal Area Management law (CGS 79-535) provides the authority for the proposals described herein. Guilford's Coastal site plan review requirements are Section 273-91 of the Guilford Zoning Code.

5.1 Building Codes

Building codes in Connecticut are adopted by the State. The municipal building officials utilize the adopted state code. The 2009 State Building Code was adopted effective December 31, 2013. The 2005 International Residential Code portion of this code regulates construction of all detached one- and two-family dwellings and all townhouses up to and including three-stories in height. The International Building Code portion of this code regulates all other construction. New rules found in the International Residential Code that are related to coastal resilience (wind as well as flooding) include the following:

- Requirement that all residential structures are to have a structural system that provides a complete load path capable of transferring all loads from their point of origin through the load resisting elements to the foundation;
- Allowance for alternative compliance using Wood Frame Construction Manual or Standard for Cold-Formed Steel Framing;
- An engineering requirement for non-conventional elements of otherwise conventional construction (but only requires engineering for the non-conventional elements);
- New wind speeds utilizing three-second wind gusts have been adopted consistent with the American Society of Civil Engineers (ASCE)-7 requirements. More accurate mapping of the State's wind speeds results in a more appropriate enforcement of the regulations;
- New design criteria for wind speeds that equal or exceed 110 MPH (the southern 1/3 of Connecticut);
- Glazed opening protection requirement (or removable fitted wood structural panels with attachment hardware) in wind borne debris regions (municipalities with basic wind speed of 120 MPH) in southeastern Connecticut;
- Requirements for engineered design of masonry or concrete foundation walls, for walls subject to hydrostatic pressure from groundwater;
- Expanded crawl space ventilation information as defined in code R408.2; 1) additional materials approved to cover openings, 2) code now allows for under-floor space (crawlspace) access through perimeter walls (16 x 24 areaway required if below grade) as option to openings through floor as defined in code R408.3; and
- Specific requirements for construction in A and V flood hazard areas, but all construction in floodways must follow the requirements of the International Building Code.

The 2009 amendments to the 2005 State Building Code and the 2005 Connecticut State Fire Safety Code were effective on August 1, 2009. However, additional code amendments are underway. The 2013 amendments adopting the 2009 International Residential Code and the

2011 National Electrical Code were subject to a public hearing held on April 10, 2013. Included in the amendments are passages regarding substantial improvement/damage determinations for structures in floodplains. This Amendment is now in effect as of the end of 2013.

The technical review process for adoption of the 2012 code family is underway by the State of Connecticut. It is anticipated that a new State Building Code based on this model will be adopted in Connecticut sometime in 2015.

In Connecticut, municipalities utilize two tools – the State building code and the local version of the National Flood Insurance Program regulations – to manage and control development in FEMA-designated flood zones. The local version of the National Flood Insurance Program regulations is typically found in the municipal code, zoning regulations, and/or subdivision regulations. This is also the case for Guilford:

- Flood damage prevention is covered by Chapter 174 of the Code of the Town of Guilford. This is essentially the local articulation of the National Flood Insurance Program regulations.
- The Floodplain District is described in Section 273-6 of the Zoning Regulations. The district is an overlay zone. Regulations for this district are provided in Section 273-89. The regulations are relatively brief and essentially express a permitting process for new or substantially improved structures in accordance with the standards provided in Chapter 174 (the Flood Damage Prevention code).
- Subdivision of land is defined in Chapter 272 of the Town of Guilford Code. In Guilford, the Planning and Zoning Commission is charged with administering Subdivision Regulations. Several components of the regulations either directly or indirectly address flood hazards.

Because Connecticut's building code relies on International Residential Code and International Building Code rather than incorporating more stringent hazard-resistant design standards into its own state-level codes, municipalities have mainly one option for increasing the design standards associated with development in flood zones: modifying the municipal code, zoning regulations, and/or subdivision regulations. This option may serve as an opportunity where Guilford can adopt a "beyond code" design flood elevation to further support coastal resilience.

The REPORT OF OPTIONS TO INCREASE COASTAL RESILIENCE describes several methods of increasing building design standards to enhance coastal resilience. These are described below:

- *Freeboard* – Freeboard standards require structures to be elevated higher than the level that FEMA requires through the National Flood Insurance Program regulations. Application of freeboard standards to coastal flood zone elevations is typically viewed as more effective than applying freeboard standards to inland flood zones. When used alone, freeboard standards provide additional certainty that flood levels will not damage a structure. When use in combination with V-zone standards described below, freeboard standards can provide an additional level of flood damage prevention. Independent academic studies have found that freeboard is one of the most effective tools to reduce flood damages. A study of the Community Rating System found that insured flood losses were reduced by almost $ 1 million in communities that require freeboard.

Municipalities in Connecticut are entitled to adopt freeboard standards, and several communities in Connecticut require freeboard as explained in the REPORT OF OPTIONS TO INCREASE COASTAL RESILIENCE. Guilford's Municipal Coastal Program and Hazard Mitigation Plan recommended that Guilford adopt freeboard. This plan likewise recommends that freeboard standards should be considered. These standards should be correlated with projected sea level rise considerations as documented in a generally accepted methodology (e.g. the Coastal Resilience tool). These standards may include *mandatory minimum standards*, *incentive based standards,* or a *combination* of the two.

- *Building Height Standards* – Liberal height standards for construction should be implemented. These standards may be based on a special permit procedure when additional building height is necessary in order to achieve other regulatory or policy goals. As such, the liberal height standards are not specifically meant to build resilience; rather they allow freeboard and other design standards.

- *Applying V Zone Standards in A zones* – The effect of this requirement would be to cause a structure in the coastal A zone to be constructed per V zone standards and incorporate breakaway walls, certain pile foundations, and prohibitions on uses below the first floor. The application of more stringent codes not only protects a given structure; it also protects *nearby* structures from damage caused by collapsing or floating structures and debris. Guilford's Municipal Coastal Program and Hazard Mitigation Plan both discuss the benefits of applying V zone standards in coastal A zones.

In addition to those listed in The REPORT OF OPTIONS TO INCREASE COASTAL RESILIENCE and summarized above, recent developments in Connecticut policy regarding shoreline flood & erosion control structures permit use of living shorelines. Such living shorelines may be designed into new "coastally adapted" communities as described in Chapter 7. Specific state statutes are 22a-109(c) and 22a-92(b)(2)(J).

The Town of Guilford will need to determine the best means of incorporating the higher building standards into current codes and regulations. Options include modifying the Municipal Coastal Program, Zoning Regulations, and Subdivision Regulations. In addition, FEMA standards regarding coastal A zones are continuously evolving and codes based on them may need to be regularly checked. For example, the Town of Old Saybrook adopted changes to its Zoning Regulations in 2012. These amendments require one foot of freeboard and the application of V zone standards in coastal A zones. The revised Old Saybrook Floodplain Management Ordinance now states the following:

- Section 2.9: "VE Zone floodplain construction standards are applied to development, new construction and substantial improvements in the Coastal AE Zone."
- Section 2.26: "The floodplain development and construction standards for VE Zones will be applied in the Coastal AE Zone."

- Section 5.3.1: "New construction or substantial improvement of any residential structure shall have the lowest floor, including basement, elevated at least one foot above the base flood elevation."
- Section 5.3.2.1: New construction or substantial improvement of any commercial, industrial, or non-residential structure located in Zone A or AE, shall have the lowest floor, including basement, elevated at least one foot above the base flood elevation; or
- Section 5.3.2.2: Non-residential structures located in all A and AE zones may be dry flood-proofed at least one foot above the base flood elevation in lieu of being elevated provided that together with all attendant utilities and sanitary facilities the areas of the structure below the required elevation are water tight with walls substantially impermeable to the passage of water, and use structural components having the capability of resisting hydrostatic and hydrodynamic loads and the effects of buoyancy.
- Section 5.3.4.2: All buildings or structures [in coastal high hazard areas] shall be elevated so that the lowest supporting horizontal member is located no lower than one foot above the base flood elevation and with all space below the lowest supporting horizontal member open so as not to impede the flow of water, except for breakaway walls as defined in Section 2.7.
- Section 5.3.7.1: New construction of critical facilities shall be elevated or dry flood proofed to one foot above the base flood elevation (100-year flood elevation).

5.2 Zoning Amendments and Other Regulatory Procedures

Zoning Regulation text amendments may be used as described above to help require freeboard and other increases in building standards. However, other changes to Zoning Regulations and the Zoning Map may be useful for increasing coastal resilience, especially if used in connection with other strategies and tools discussed in prior chapters of this report.

- *Tidal Marsh Protection and Advancement* – Areas suitable for tidal marsh advancement may be regulated under a resource protection model of management. Permits may be required for building, excavation, grading or other activity in areas either designated by mapping or meeting prescribed criteria. These areas may also be designated for acquisition or for development rights transfers.

- *Transfer of Development Rights* – The transfer of development rights from coastal areas should be encouraged both within the coastal area and to areas outside the zone. These procedures should be simplified and facilitated by the Town both through regulation and the creation of markets (refer to the discussion of property acquisition in Section 6.0).

- *Flexible Development Process* – Greater use of flexible development rules should be encouraged in Guilford. Clustered development, planned residential development, and open space subdivision procedures should be incentivized in order to protect important resources and allow development that is consistent with coastal resiliency goals.

- *Land Conservation for Marsh Advancement* – If land cannot be acquired for tidal wetland advancement as discussed elsewhere in this plan, there may be opportunities to set aside the appropriate land through conservation easements and other arrangements. In some cases, this may occur through the use of "rolling easements" which are described in the REPORT OF OPTIONS TO INCREASE COASTAL RESILIENCE. In other words, Guilford would not acquire private properties; instead, these properties would continue to remain in private ownership and tidal wetlands would be allowed to advance inland as structures are removed.

- *Septic System and Other Sewage Disposal Options* – More flexibility in rules governing sewage disposal system design should be developed in order to address the issues and opportunities discussed in Section 3.3. Particularly important are provisions allowing for sharing of sewage disposal systems by multiple property owners. This may eventually require changes in the Connecticut Public Health Code.

- *Green Infrastructure such as Living Shorelines for Private Property and Homeowner Development* – Where homeowner and other property owners propose green infrastructure improvements, bonuses and other property development incentives should be allowed (e.g. increased building height, coverage, reduced setbacks, etc.

- *Water Dependent Uses* – Water dependent uses are typically more resilient in the long term as compared to residential land uses. Zoning should be liberalized to allow and encourage commercial water dependent use in residential zones in order to compensate property owners for loss of value due to restricted residential development opportunities.

- *Expedited Permits for Reconstruction after Emergency Events* – Procedures should be created for expedited permitting of repairs and reconstruction after emergency events for work which meets new standards of coastal resiliency. These standards could include any of the strategies presented in this plan such as freeboard standards, green infrastructure, marsh migration protection, shared septic systems, etc.

- *Residential Building Design Challenges* – With major changes in the design of residential property and the consequent change in character of coastal neighborhoods, new and innovative design concepts need to be developed. The Town should foster design competitions to explore the possibilities of new types of buildings which accomplish coastal resilience goals and preserve and enhance coastal neighborhood character in accordance with other community design goals and values.

5.3 Zoning Map Overlays

Guilford may wish to adopt a zoning overlay district that is delineated using a line of future daily inundation or a future storm of a given hurricane category/intensity. Any of the planning periods used in the coastal resilience tool could be used (2020s, 2050s, or 2080s). Once adopted, the town could enact any number of requirements for development or redevelopment within the overlay, including freeboard and application of V zone standards in coastal A zones (if not already incorporated into Zoning Regulations or municipal code) or a more stringent level of

freeboard such as two feet. Other possibilities may include variable setbacks and buffers or restrictions on what types of renovations or expansions may be permitted for existing buildings.

In general many of the strategies discussed in this plan could be linked to overlay zones as a means of furthering coastal resilience for particular properties located in an overlay zone that may be seeking various development or redevelopment permits. The following are strategies, tools, and requirements that can be tied to overlay zones:

- Automatic referrals to other agencies and commissions for advisory reports
- Automatic referrals to other agencies and commissions for consideration of potential offers for acquisition[2]
- Automatic referral to building department for review and report of prior storm and flood damage
- Automatic referral to other agencies and commissions for calculation of benefit-cost ratio to advise whether FEMA mitigation funds could be used for acquisition
- Allow and encourage commercial water dependent uses in residential zones in order to compensate property owners for loss of value
- Relaxed transfer of development rights
- Relaxed approvals for clustered development, planned residential development, or open space subdivision procedures
- Provisions for property tax relief for property owners that set aside suitable marsh advancement areas
- Incentives for residential building design challenges
- Freeboard (as opposed to *no freeboard* elsewhere in town)
- Freeboard (*higher level of freeboard* than the rest of the town)
- Application of V zone standards in coastal A zones
- Required identification of reserve areas for new septic systems, mounded systems, holding tanks, and/or possible shared systems
- Requirements for maintaining hard shoreline structures (if any are located on the property)

It may be difficult for the town to prohibit certain land uses in overlay zones if the underlying zoning district already allows the land use. Therefore, the overlay zone concept should be used as a method for guiding *how* development could occur that is consistent with the land use allowed by underlying zoning, yet helps achieve overarching resilience goals. This plan recognizes that overlay zones are not necessary for the above strategies to be pursued. Overlays are simply a tool that could expedite and facilitate the use of particular strategies identified in this plan.

[2] Ideally, the town will target specific properties for acquisition prior to these properties coming forward for development or redevelopment approvals and permits.

5.4 Private Residential Property

The previous sections have described measures that are necessary to protect shoreline lands, associated community infrastructure, and natural resources. This section describes various measures that may be employed by individual property owners in order to adapt to the changing conditions, reduce flood damage, and retain property values for as long as it remains practical. An additional benefit of enacting such measures should also result in a reduction of the potentially burdensome flood insurance rates.

These tools include adopting, enacting, and/or adhering to changes in the building codes, zoning amendments and zoning map overlays as discussed in this chapter. For example, private residential homeowners could voluntarily go "beyond code" to modify their property to the standards as described above before or without being required to do so by law. Incentives for doing so include possible beneficial impacts on property values, justification for reductions in flood insurance costs, and an overall ability to remain living in high-risk coastal areas for a longer amount of time.

Beyond measures taken on by individual property owners, there are also near-term opportunities for collective action within neighborhoods or "zones of shared risk" as defined in Chapter 7. Groups of citizens may organize to conceive of alternative futures for their regions that respond to ongoing changes along the coast. Examples of what these planning processes may attend to are provided in Chapter 7, and how they might be organized to facilitate an effective, collaborative working environment for such planning in Appendix E. These group efforts are in addition to those aimed to garner support for zoning amendments, overlays, and infrastructure investments (see Chapters 2, 3, and 4) that more adequately address risks at the neighborhood scale. Moreover, such collective efforts represent an alternative outside of the traditional binary of "government mandated" or "market-driven"; both of which rely on external factors for change. Instead, collective approaches led by committed citizens and property owners enable individual and shared responsibility for extending the viability of coastal communities.

These approaches have broad applicability as some of the oldest communities in Guilford are in the shoreline areas. For example, the Sachem's Head area was established as a summer colony in the late 1800s. In addition to their historic and social importance, these areas are a disproportionate part of the Town's tax base. For all of these reasons the Town is seeking strong community involvement in setting priorities to allow the residents in these areas to maintain their properties for as long as reasonably possible in the face of changing coastal condition. Doing so may be aided by learning from other places facing similar challenges. These places benefit from a shift in mindset that reflects a desire to "make room for living with the water" as much as they do from implementing physical adaptive measures. Strategies to enable this shift are discussed in Appendix E.

Lastly, although the title and scope of the next chapter is "property acquisition" should circumstances require its use, it must be noted that all of the aforementioned citizen-driven strategies are ideally more suitable for advancing coastal resilience in Guilford.

6.0 PROPERTY ACQUISITION

The Municipal Coastal Program (2008) noted that coastal land acquisition should be pursued for both ecological protection and human use. Coastal land conservation values include lands with ecological significance, existing potential coastal recreation opportunities, and areas of exceptional or unique coastal conservation value. These properties were recommended for evaluation in terms of their ecological significance as a result of their high quality or scarcity in the region or State. Important considerations were the proximity to other protected lands as well as providing areas for sea level rise and tidal wetlands migration. Sites included were undeveloped islands, intact areas of tidal marsh, undeveloped tidally influenced riverine systems (i.e. East River tidal areas), coastal woodlands, bird habitat areas (especially waterfowl areas), anadramous and diadramous fish run areas, and sites that have been shown to have habitat for Federal or State listed threatened, endangered, or species of special concern.

Coastal recreation access areas considered for purchase included the following considerations: enhancement of public access to coastal resource based recreation; provision of access to shellfishing areas that currently have insufficient public access as deemed by the Guilford Shellfishing Commission and Land Acquisition Commission; other fishing, crabbing and hunting access; access to areas suitable for boating, including canoe and kayak areas; access to swimming; and scenic overlooks including wildlife observation areas.

With the new data provided in the Hazard Mitigation Plan and the RISK AND VULNERABILITY ASSESSMENT REPORT, several areas of Guilford's shoreline may be inundated by water or damaged by serious coastal storms by the year 2060. These properties are comprised of residential, commercial, industrial, recreational, and open space properties. It is recognized that the Town has a significant amount of land already protected in the coastal area. Some of these properties may be subject to the effects of sea level rise and erosion from coastal storms.

Categories of Property Acquisition

Acquisition of property in flood prone areas and areas susceptible to sea level rise should be considered in order to achieve this plan's goal of coastal resiliency while also providing for public safety, marsh migration and, in some cases, public access to the shoreline. Property acquisition will generally fall into four major categories:

1. The first includes open space and other undeveloped land. Priority purchases of this type should include tidal marsh advancement areas, and land suitable for public access and recreation. Adjacency to existing public or protected lands should be a consideration. The Town, the State of Connecticut, the Guilford Land Conservation Trust and the Connecticut Audubon Society all own coastal lands and should be encouraged to acquire more under this program.

2. Existing developed property may also be acquired pursuant to this plan. In areas such as Seaside Avenue and Neck Road, housing that is already damaged or vulnerable to future storms and sea level rise could potentially be acquired.

3. In situations where on-site solutions are not feasible for providing a potable water supply and disposing of sanitary wastewater and community or town wide system are not possible due to feasibility or expense, some properties may be rendered unusable. As these facilities are damaged beyond reasonable repair or as septic system failures require that properties be vacated, the town may acquire the lots.

4. Inland properties may also be acquired to make up for the loss of lands such as the playing fields at Calvin Leete School and Chittenden Park due to the projections of marsh advancement onto these properties.

The concept of 'sending' and 'receiving' zones is important to consider in the context of property acquisitions for the second and third categories above. As occupied properties are acquired, residential and non-residential structures and populations will need opportunities to relocate including to alternative locations in Guilford. Sending zones will be those areas that are acquired, or in some cases will be areas that are vacated without any action on the town's part. Receiving zones will be those areas where structures and populations are established.

Over time, development of inland transit-oriented development zones could occur as a result of, and in connection with, the sending/receiving zone concept. The town's participation will likely be needed to facilitate an organized and thoughtful method for a strategic restructuring of areas such as Seaside Avenue and Town Center South, which are described in Section 7.2.

Vehicles for Property Acquisition

Section 8.3 of this plan describes the Town exploring four alternative institutional arrangements with the authority and resources to implement the property acquisition elements of this plan. These institutions would require state statutory authority to buy and sell property, develop or retire real estate, raise capital, and retain staff. Each of these arrangements has different strengths and weaknesses that would need to be vetted. Similar to a development or redevelopment authority, these entities could expeditiously act in accordance with the Coastal Resilience Plan and specific neighborhood plans. Private entities would also be appropriate vehicles for acquisition.

Options for acquisition tools are listed in Table 6, each with their respective challenges and opportunities relative to enabling coastal resilience. As stated in the previous chapter in section 5.4, the use of any acquisition tool would ideally be based on mutual consent and support within the areas of their use.

Table 6: Example Strategies for Acquiring Land

Acquisition Option	Details	Challenges	Opportunities
Buyout at fair market value	Purchase targeted property at fair market value Examples of where/how this may locally apply in Chapter 7 CT Example: Plainville, Connecticut 2012 - 2014	- Availability of funds - Consent of property owner - Mismatch between appraised vs. market value - Possible loss of local tax base due to relocation	- Market-based; comparatively less contentious - Comparatively fewer legal obstacles - Can proceed as quickly as consent and availability of funds allows - Guaranteed acquisition
Buyout at fair market value with incentives	Incentivize sale at fair market value with bonus payment E.g. NY Rising Buyout and Acquisition Programs offering 5-15% incentives above fair market value for purchase of homes in storm-damaged targeted buyout areas, contingent on resettlement within the same county	- Availability of funds - Consent of property owner - Mismatch between appraised vs. market value	- Market-based; comparatively less contentious - Comparatively fewer legal obstacles - Can proceed as quickly as consent and availability of funds allows - Incentivizes preservation of local tax base - Guaranteed acquisition
Targeted information campaign on long-term costs and risks of remaining in vulnerable area	Encourage willingness to sell with information campaign E.g. Community education; mandated disclosure of property risks for sellers of real estate	- Information changing rapidly - Information open to interpretation - Comparatively slow - Does not guarantee acquisition - Possible loss of local tax base due to relocation - May generate confusion or unintended backlash	- Comparatively lower cost - Builds public awareness about challenges facing the coast - Consent resides with property owner
Strategic zoning	Use downzoning to limit post-storm reconstruction, as well as other zoning tools, such as overlay zones with setback and height restrictions Examples discussed in Chapter 5	- Requires sequence of plan development and approvals - Comparatively slow - May be susceptible to legal challenges - Does not guarantee acquisition	- Comparatively lower cost - Allows for timed phasing of physical risks and shifts in tax base
Tax incentives	De-incentivize development by basing property tax assessment on current use value instead of fair market value in certain conservation areas; Encourage relocation through tax credits. Local examples in Chapter 7	- Availability of funds (i.e. reduction in tax revenue) - Mismatch between appraised vs. market value - Does not guarantee acquisition	- Consent resides with property owner - Can include incentive for no net loss to local tax base

Transferable Development Rights	Guide development from "sending" to "receiving" zones through market-based exchange of development rights Examples of where/how this may apply in Chapter 7	- Requires adequate "receiving zone" within local tax jurisdiction - Uncertain timing; comparatively slow - May require new regulatory framework, including zoning changes - Does not guarantee acquisition	- Enables an increased availability of viable, risk-reduced properties - Incentive for no net loss to local tax base - May accomplish development goals with minimal public cost - Consent resides with property owner
Conservation easements	Limit development in target areas by acquiring, encouraging, or incentivizing conservation easements, may include education about federal tax benefits. CT Example: Too numerous to list	- Requires sequence of plan development and approvals (if municipality purchases easements) - Consent of existing property owners - Comparatively slow - May only achieve partial limits on development - Availability of funds (if municipality purchases easements)	- Comparatively lower cost, particularly if easements are donated - Allows for timed phasing of physical risks and shifts in tax base

While not represented in Table 6, it is noted that eminent domain, whether outright or through conditional lease, remains a legal means of property acquisition for public purposes (CGS Title 48). However, multiple aspects of eminent domain make it the least desirable alternative for land acquisition. Legal justification, lack of owner consent, public dissatisfaction and backlash, availability of funds, and susceptibility to ongoing legal challenges are all challenges associated with this means of acquisition. Therefore, the range of acquisition options described above in Table 6 are more ideally suited for addressing the challenges of coastal adaptation over the next multiple decades.

Funding of Property Acquisition

In addition to conventional funding sources (Town Bond Issues, State grants, etc.) it is expected that Federal funding opportunities for building resilience may be available via the FEMA mitigation programs. These programs are described in Section 8.4. For the FEMA mitigation funds to be utilized, acquisitions must meet the criteria of having benefit-cost ratios that exceed 1.0 when evaluated using the FEMA benefit-cost analysis. Alternative methods of evaluating the benefit-cost ratio are not permitted when these specific mitigation funds are being sought. Typical parameters for generating benefit-cost ratios above 1.0 include reasonable market values of land combined with frequent flooding. Properties with inflated values and infrequent flooding will not achieve these ratios, but other candidates for funding may be sought.

As another option, the Town could finance acquisition and redevelopment through private sources. This could perhaps occur through the coastal authority described above.

Finally, the Town should consider special tax districts as a vehicle for funding. This source could be particularly appropriate where the benefits of an acquisition (or other public improvement) are limited to a particular neighborhood or group of property owners.

7.0 FUTURE PLANNING IN ZONES OF SHARED RISK

Guilford's coastal neighborhoods are diverse and it is likely that each will be faced with a combination of vulnerabilities to sea level rise and the increased incidence and severity of coastal storms. A combination of adaptation measures will therefore be necessary in each neighborhood in order to reduce risks and increase resilience.

This chapter illustrates two scenarios for combining and phasing coastal adaptation strategies to promote coastal resilience in Guilford. These strategies include protective infrastructure in the form of hardened and living shorelines; mitigation infrastructure such as roadway, water supply, and wastewater treatment modifications; natural resource protection in the form of planning for marsh advancement; regulatory changes to accommodate future conditions; and strategies for land acquisition and redevelopment. The evaluation, prioritization and implementation of each of these strategies will require considering a system of negotiations and investments in order to increase resilience and reduce real and perceived risks in the face of climate change.

One way to evaluate, prioritize, and implement such a system of coastal adaptation strategies is to consider how they may be applied in "Zones of Shared Risk." Zones of Shared Risk are regions that face common challenges either in existence already or caused by climate change, and therefore risks are shared among or between groups of people that may have different perspectives and priorities for coastal resilience. A Zone of Shared Risk includes the houses, land, infrastructure, hydrological, ecological, social, and institutional elements that contribute to the functioning of a particular place.

Guilford has multiple Zones of Shared Risk within and across coastal neighborhoods, where people in each face numerous risks and vulnerabilities outlined in the RISK AND VULNERABILITY ASSESSMENT REPORT. Guilford's Zones of Shared Risk span specific areas such as Sachem's Head, Mulberry Point, Old Quarry Road, Soundview Road, Seaside Avenue, and Neck Road. These zones are useful for considering how to proceed with coastal adaptation for particular reasons:

- Their spatial scale is conducive to planning for and implementing technical measures such as protective infrastructure and zoning overlays;
- Their definition as systems that include physical and social attributes may make them more attractive to funding sources such as FEMA (and others listed in section 8.4), and representative of the dynamic relationship between people and their surrounding environment;
- They can leverage existing social institutions such as formal housing associations and informal community relationships to provide platforms for ongoing citizen involvement in ongoing processes of coastal adaptation.

This chapter describes the extent of Zones of Shared Risk across Guilford and then provides examples for two Zones of Shared Risk to systematically implement the adaptation strategies contained in this report and thereby increase their coastal resilience. The specific adaptation strategies presented on the ensuing pages are not recommendations, but are exemplary of the scale and vision required to prepare for changing coastal conditions. Projections for the 2020s,

2050s, and 2080s are the basis for planning the future coastal conditions. However, how Guilford and its residents choose to adapt is open-ended, and the conceptual designs for two Zones of Shared Risk are intended to be the beginning of an ongoing planning process that must simultaneously occur at the town scale and within all Zones of Shared Risk.

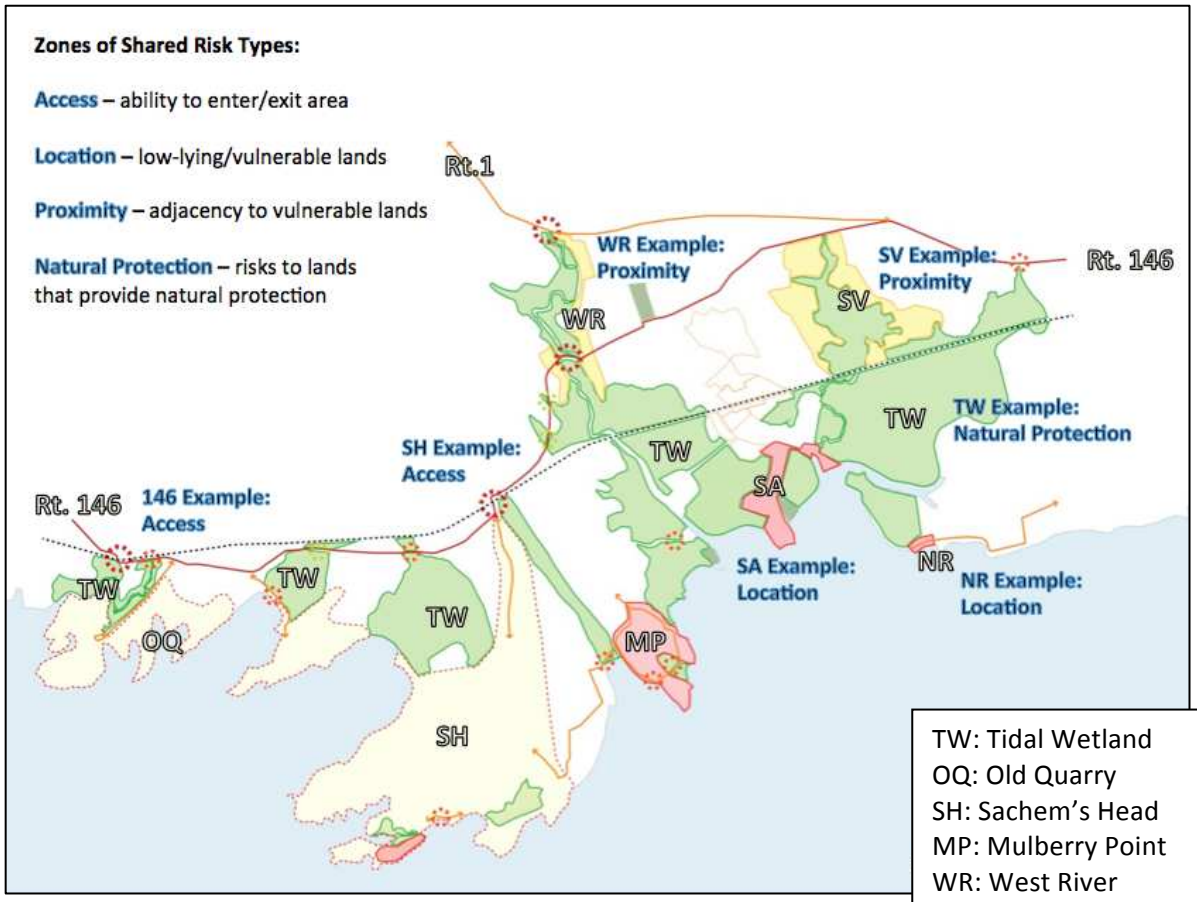


Figure 5
Zones of Shared Risk Types Within Guilford

Four general types of Zones of Shared Risk are identified in Guilford:

- An access Zone of Shared Risk contains risks primarily derived from the ability (or lack thereof) to enter or exit an area due to flooding caused by increasing sea levels or surges associated with strong storms. Examples of access Zones of Shared Risk within Guilford include Old Quarry Road, Route 146, and Sachems Head.
- A location Zone of Shared Risk contains risks primarily derived from a prevalence of low-lying lands within an area. These lands are vulnerable to flooding caused by increasing sea levels or surges associated with strong storms due to their low elevation. Examples of location Zones of Shared Risk within Guilford include Seaside Avenue and Neck Road.

- A proximity Zone of Shared Risk contains risks primarily derived from adjacency to low-lying, vulnerable lands. These lands are vulnerable by being close to areas that will experience more flooding caused by increasing sea levels or surges associated with strong storms, and are likely to experience some flooding of their own. Examples of proximity Zones of Shared Risk within Guilford are Soundview Road and the West River area.
- A natural protection Zone of Shared Risk contains risks to lands that provide natural flooding protection. These lands can attenuate flooding and damage and flooding from storm surges, contribute to both improved water quantity and quality in non-storm events, and provide valuable habitat. This Zone of Shared Risk type often overlaps with the other three types. Examples of natural protection Zones of Shared Risk in Guilford are tidal wetlands.

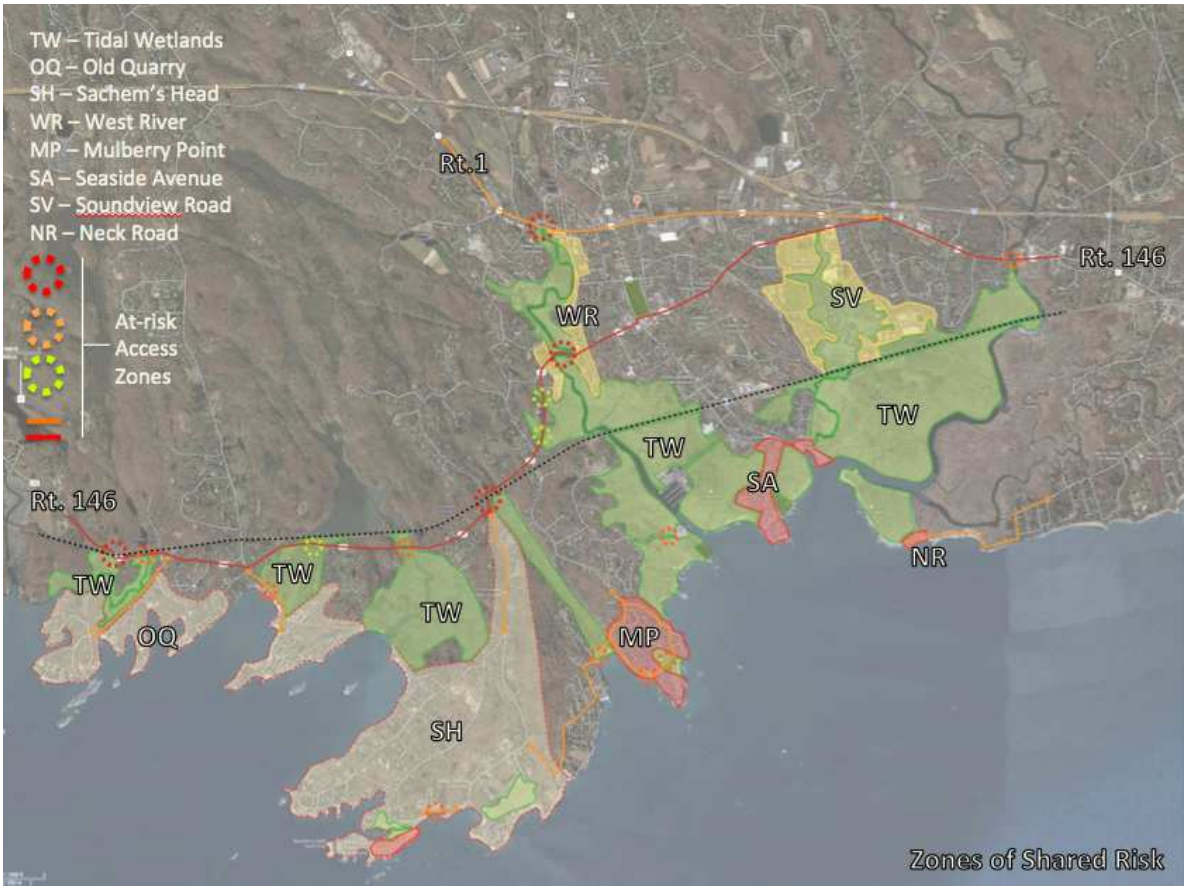


Figure 6
Zones of Shared Risk with At-Risk Access Zones

In addition to these general types, Zones of Shared Risk are also applicable to regional elements including transportation infrastructure such as Route 146, which crosses three coastal municipalities. Within this regional Zone of Shared Risk, municipalities can target specific points of concern where Route 146 crosses under the Amtrak line, or low lying roadways adjacent to wetlands with modified hydrology that experience frequent flooding. One of the challenges will be prioritizing projects given the multiple locations requiring alterations. Guilford has already

selected several locations and allocated some funding to upgrade infrastructure and mitigate flooding impacts.

Each Zone of Shared Risk will require detailed coastal adaptation planning to document the range of technical strategies available for the site, engagement strategies to provide people in these zones with a means to overcome differing perspectives on coastal adaptation, and means of coping with the economic implications. Two examples of how planning could proceed in Zones of Shared Risk are provided below.

7.1 Soundview Road

Soundview Road was a key area of discussion in the RISK AND VULNERABILITY ASSESSMENT REPORT. The Soundview Road/Shoreline Drive corridor is an important area of commercial/industrial vulnerability in Guilford. Approximately 15 businesses are located along Soundview Road and Shoreline Drive, and most of them are presently in hurricane surge zones and the coastal Special Flood Hazard Area, with the exception of the post office distribution facility on Shoreline Drive and the daycare center at the corner of Soundview Road and Route 146. Thus, the majority of the business and most of the roadway are already at risk to coastal flooding. Therefore, risks will increase over time. Some of these businesses can be easily relocated while some cannot be easily moved. The tax base and employment provided by the Soundview Road businesses are important to the Town of Guilford and therefore reducing risk will be important.

Hazardous materials, fuels, and products are stored and used at some of the businesses along Soundview Road, making them more vulnerable to damage on-site as well as increasing vulnerability for surrounding properties that may be exposed to fire or pollution in the event of a release. The economic implications could include the need to repair damaged facilities as well as the costs of responding to hazardous materials incidents and the aftermath.

With reference to Figures 16 and 17 in the RISK AND VULNERABILITY ASSESSMENT REPORT, non-storm inundation may occur in spots along Soundview Road as early as the 2020s, whereas longer sections of the road could be inundated on a daily basis by the 2050s and 2080s. With reference to Figure 7 in the RISK AND VULNERABILITY ASSESSMENT REPORT, marsh advancement zones are anticipated along Soundview Road and at the edges of the businesses located along the road. Two properties (Algonquin and East River Energy) are predicted to be completed overtaken by marsh advancement (based on ground surface elevations) if allowed to do so.

The total assessed value of properties on Soundview Road and Shoreline Drive is $24,085,759. The taxed value is 70% of this figure, and the annual revenue at the current mill rate is $362,828. Although this is only about 2% of the total coastal tax revenue in Guilford, some of the businesses along the road are among the key employers in Guilford.

Figure7 presents a potential conceptual design for addressing vulnerabilities, decreasing risk, and increasing resilience in the Soundview Road corridor. Daily inundation and coastal storm flooding may begin to impact the lowest section of the road (between Algonquin and the gymnastics studio at 301 Soundview Road) more frequently by the 2020s.

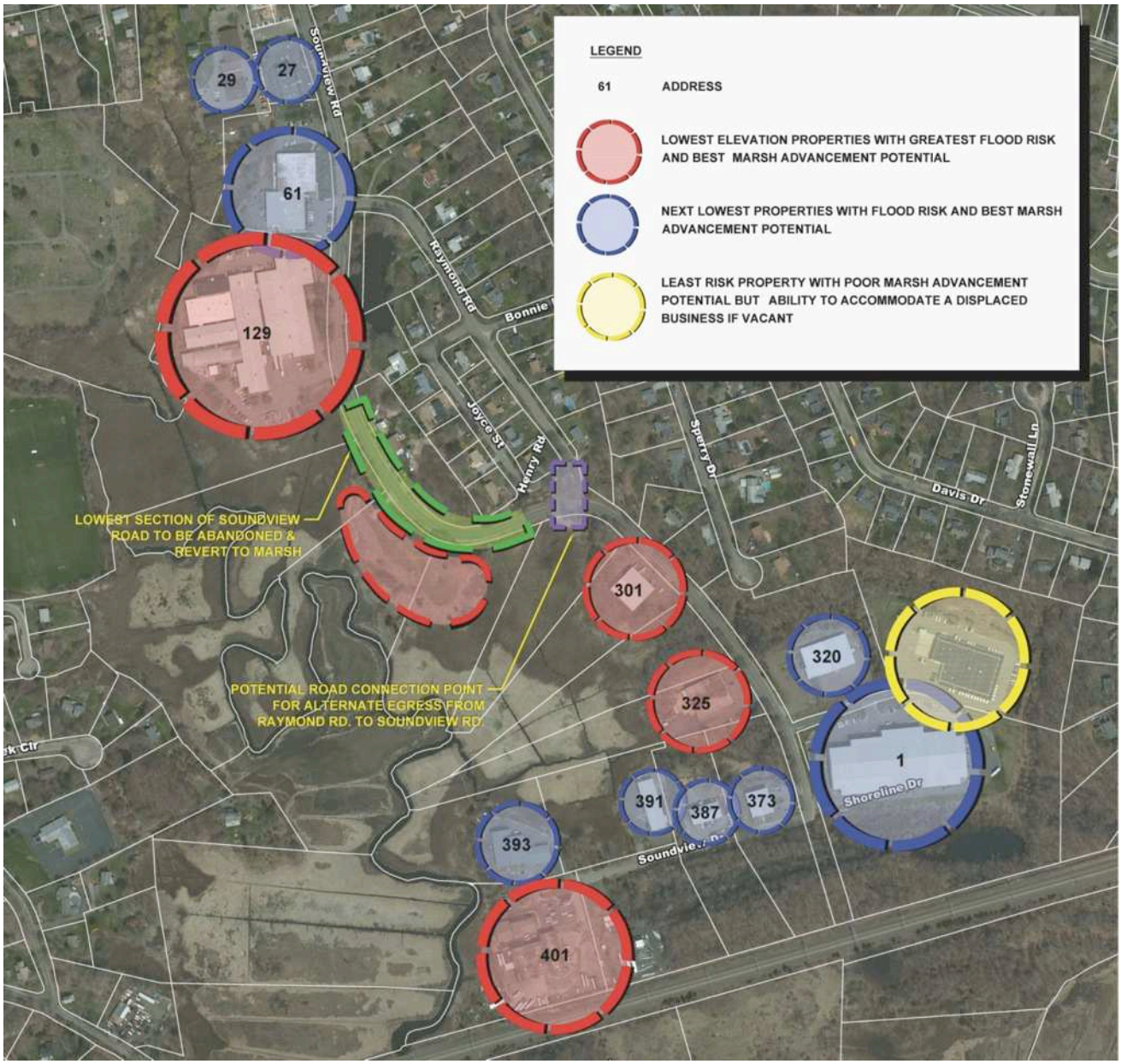


Figure 7
Soundview Road Shared Risk Plan Example

This lowest section of the road could be elevated and regularly maintained, or it could be abandoned in favor of making a new roadway connection from Raymond Road to Soundview Road. The new connection would be more resilient to flooding due to the higher ground surface elevation. This new connection would provide access to businesses beyond (south of) the lowest section of the existing road. A new driveway would need to be extended to the single home located on Soundview Road.

Undeveloped land is currently for sale on the west side of Soundview Road along this low section. This land is a prime contender for marsh advancement and a poor candidate for commercial development, as any buildings constructed on the site would need to be built per the National Flood Insurance Program regulations and therefore floodproofed to the base flood elevation. The town may consider acquiring the land as open space for marsh advancement.

The properties with buildings at the lowest elevations are Algonquin (129 Soundview Road), the gymnastic studio (301 Soundview Road), East River Energy (401 Soundview Road), and 325 Soundview Road. These properties have the greatest risk of daily inundation and coastal storm flooding, and the greatest potential for marsh advancement. The town may wish to work with these property owners to relocate the businesses elsewhere along Soundview Road (to lots with higher elevations), elsewhere in Guilford, or elsewhere in the greater New Haven region. If relocated elsewhere along Soundview Road, one site of interest is the post office facility on Shoreline Drive. This facility is currently operational, but post office functions are sometimes shifted geographically as operations are consolidated. The town should periodically seek to understand the long-term USPS plans for this site.

The properties with buildings at the next-lowest elevations include the remaining addresses on Soundview Road and Shoreline Drive. These are clustered on the west side of Soundview Road north of Algonquin, and on both sides of Soundview Road south of the gymnastic studio. Depending on future conditions, the town may wish to work with these property owners to relocate the businesses elsewhere in Guilford or elsewhere in the greater New Haven region.

One alternative to relocating businesses from the Soundview Road corridor is to facilitate dry floodproofing of all buildings while relocating, enclosing, or elevating materials stored in yards. This approach would enable businesses to remain in current locations, but would make each of them more resilient over time. Temporary shut-downs would need to be tolerated during flood conditions, but businesses would presumably recover more quickly if losses were not sustained. This is coastal resilience.

Changes in the Soundview Road corridor should be phased over time. Given the variety of elevations found at commercial properties, flood risk will not be equal among all properties as time passes. Likewise, some sites will not be ideal for marsh advancement. A reasonable sequence for phasing would be as follows:

1. Make access through the low spot of Soundview Road more resilient to flooding, preferably by connecting Raymond Road but secondarily by elevating this section of the road.
2. Acquire the undeveloped land along this low spot and set it aside for marsh advancement.

3. Work with owners of the lowest properties to relocate and return the sites to undeveloped conditions, or dry floodproof their buildings and relocate, enclose, or elevate materials stored in yards.
4. Work with owners of the next-lowest properties to relocate and return the sites to undeveloped conditions, or dry floodproof their buildings and relocate, enclose, or elevate materials stored in yards.

A combination of options may be ideal in the future, with the lowest-lying sites acquired and businesses relocated elsewhere in Guilford, but the next-lowest sites may choose to focus on floodproofing in place.

Figure 8 presents a potential future scenario for the Soundview Road corridor. The underlying assumption for this scenario is that commercial occupants have relocated, but Guilford may one day need some of this land for residents that have relocated from other coastal areas. This conceptual design shows that the lowest-lying properties would remain vacant for marsh advancement. However, residential units could be constructed on higher ground at the northern end of the road and in a narrow band from Shoreline Drive through the southern leg of Soundview Road. These units would be in the Special Flood Hazard Area and therefore would be constructed according to the National Flood Insurance Program regulations as modified by future zoning in Guilford. For example, if future zoning regulations require two feet of freeboard, the first floors of new housing units would be elevated two feet above the base flood elevation that appears on the Flood Insurance Rate Map[3] that is effective in the future.

Individual septic systems may not be viable in these floodprone areas, so a community system could be developed on the highest land occupied by the post office distribution center. The viability of a community system would be subject to appropriate soil conditions.

Section 6.2 of this document describes the potential use of "Residential Building Design Challenges" to explore the possibilities of new types of buildings that accomplish coastal resilience goals and preserve and enhance coastal neighborhood character in accordance with other community design goals and values. Future development of the Soundview Road area could be a result of a design challenge.

[3] FEMA has the authority to produce new Flood Insurance Rate Maps over time.



Figure 8
Soundview Road Future Land Use Example

7.2 Seaside Avenue

This section focuses on Seaside Avenue and how it relates to neighborhoods south of Amtrak as a Zone of Shared Risk. Nested between the East and West Rivers and their associated tidal marshes, this low-lying Zone of Shared Risk faces numerous challenges as it contains a diverse sample of infrastructure, land and real estate conditions, public amenities, and natural resources that will be essential to consider across Guilford's other coastal areas. Coastal adaptation in Zones of Shared Risk like Seaside Avenue will require communication and collaboration among local government bodies and existing residents, as well as state and federal agencies. Such collaboration and communication is outlined in Section 8.0.

The sea level rise projections of 9, 26, and 52 inches above the 2012 Mean High Water baseline for the 2020s, 2050s, and 2080s, respectively, have implications for Seaside Avenue. Low-lying land and a lack of bedrock bluffs characteristic of other areas of Guilford increase risk and limit adaptation options. Municipal infrastructure and both private and public lands are anticipated to be impacted. Devising implementable solutions for coastal adaptation will require multiple entities spanning private homeowners, local government, finance and insurance institutions, and state and federal agencies. Storm surges associated with extreme weather events pose impacts beyond those associated with projected sea level rise. Such extreme weather events flood further inland and impact higher ground. Storms present additional challenges that will require planning and design standards for public land management and neighborhood to household scale strategies to accommodate these events of elevated risk.

Adaptation strategies will require significant communication and collaboration among local government bodies, existing residents, as well as state and federal agencies. Such collaboration and communication is outlined in Section 8.0 of this plan. In particular, this plan recommends that a series of public planning charrettes should be convened to increase awareness of these conditions and expand on adaptation options developed through resident engagement.

Seaside Avenue currently enables access to roughly 50 properties, a public beach, recreational fields and coastal wetlands. According to Guilford's Assessor, these properties' real estate assets are currently valued at over $27 million dollars, and contribute approximately over $500,000 annually in town property taxes. The average date of construction for all homes accessed by Seaside Avenue is the 1950s, and many properties have been sold and purchased within the last 12 years, increasingly at prices below the purchase cost.

The projected severity of future coastal conditions for such low-lying land suggests that difficult yet strategic decisions need to be made to ensure the viability, safety, and resilience of this neighborhood. Residents located along the coast face safety risks and real estate losses. They have an incentive to "wait out" current real estate conditions to ideally see the monetary value of their investment rise while risks of sea level rise and extreme weather events are projected to simultaneously increase. Timing and mismatched incentives makes justifying local government investment in protective infrastructure (e.g. bulkheads and shoreline armoring) and mitigating infrastructure (e.g. access roadway improvements) challenging. Such difficulty in justifying access improvements has implications for ongoing provision of emergency services.

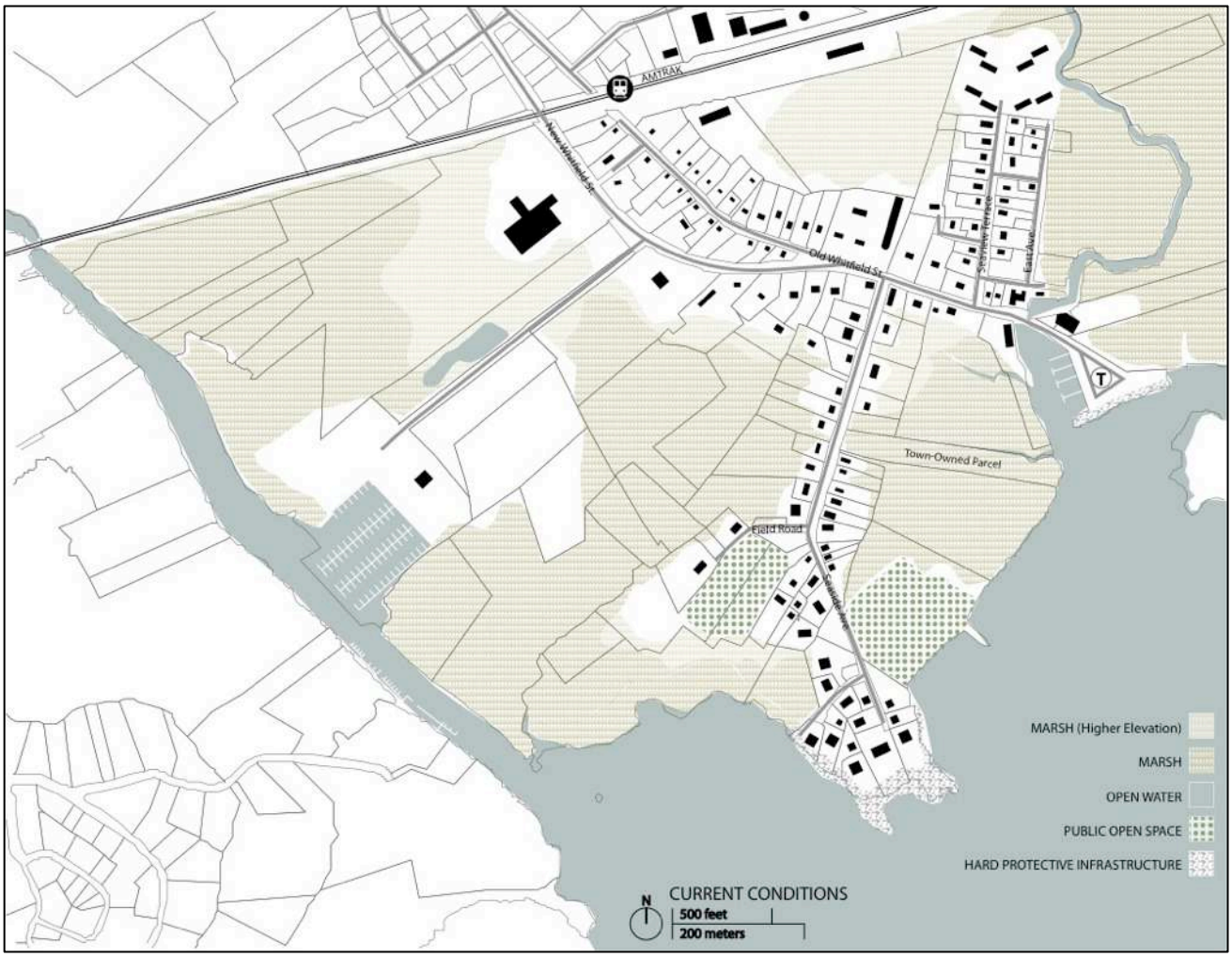


Figure 9
Seaside Avenue Current Conditions

One possible overarching adaptation strategy in the wake of these conditions in the Seaside Avenue neighborhood is to create a phased implementation of "sending and receiving" zones with proposed inland transit-oriented development (TOD). These strategies are discussed below. For each stage of three successive stages, proposed adaptation and resilience actions are listed within three categories: *Land Acquisition and Relocation, Protective Infrastructure, and Mitigating Infrastructure.*

Stage 1 Zone of Shared Risk Example Plan (Figure 10)

Near term conditions in the 2020s project an estimated sea level rise of 9 inches above 2012 mean high water levels, with additional amounts due to storms that may occur at higher frequency. This slight rise is sea level combined with continued flooding associated with

extreme storms may have widespread impacts to the Seaside Avenue neighborhood given the prevalence of low-lying land; multiple properties may experience flooding twice daily with such a small increase in water level.

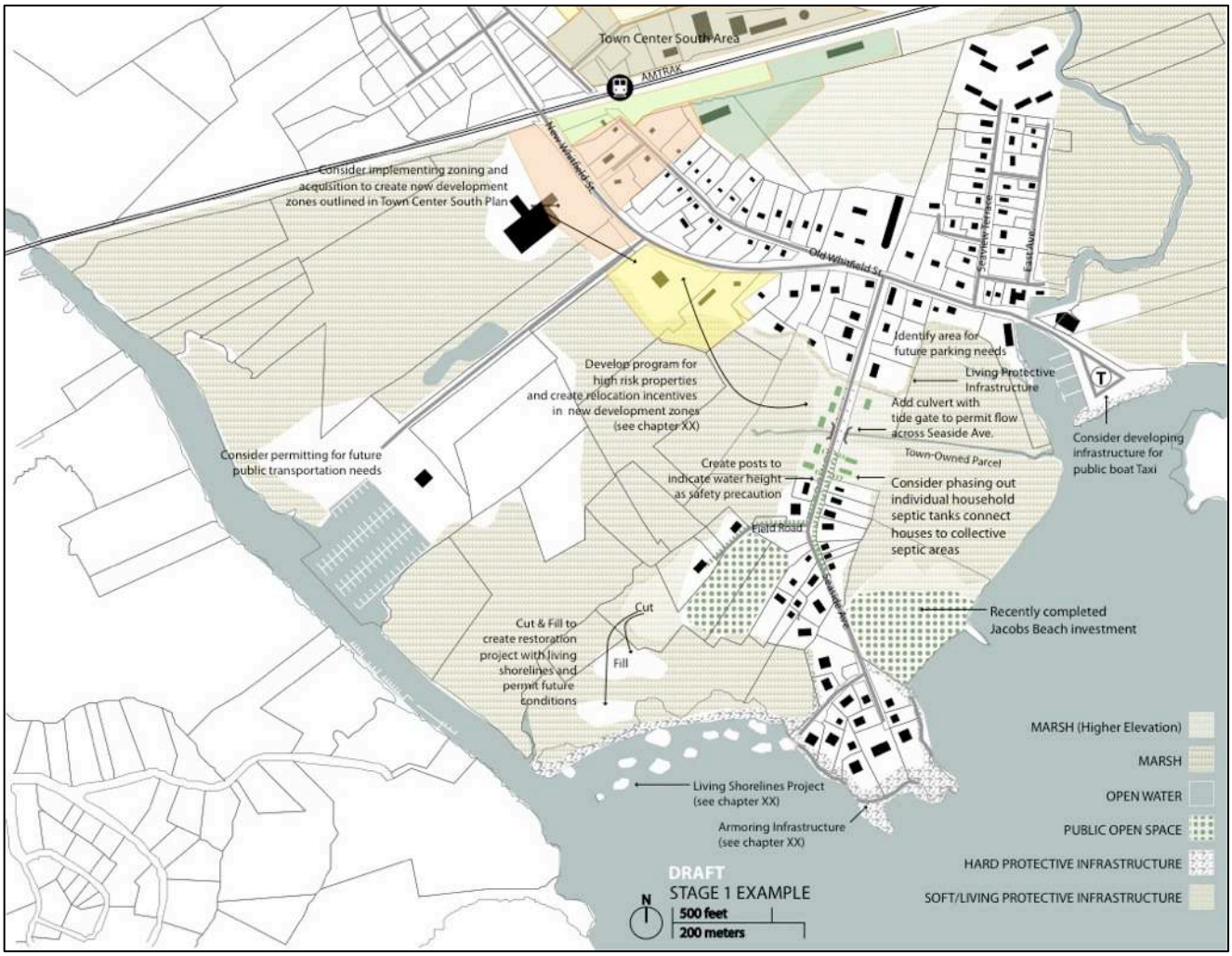


Figure 10
Seaside Avenue Stage 1 Zone of Shared Risk Plan Example

Land Acquisition and Relocation

- Consider establishing 'sending' and 'receiving' zones as a framework for negotiating land use change (see section 5.0)
- Consider acquiring low-lying land parcels on Seaside Avenue (see section 5.0)
- Consider grading land to create upland communal septic and areas for marsh advancement (see sections 3.2 and 4.0)

The lowest and most vulnerable properties are located in the middle of Seaside Avenue and include an undeveloped town-owned parcel that is mostly marsh. This 'sending' zone may serve as a catalyst for a town acquisition program that can expand across Guilford's coastal at risk properties (see section 5.0). Homeowners from acquired properties may be offered priority for new property made available within Guilford's Town Center South planning area located further inland, which may function as a 'receiving' zone for residents (see orange, yellow, and green colored regions in Figure 10). This program may be established in partnership with private developers, and is further discussed in section 5.0.

Protective Infrastructure

- Consider conversion of acquired parcels into collective septic system uplands and restored lowlands (see section 3.2)
- Consider creation of a channel for increased hydrologic connectivity across Seaside Avenue (see section 3.2)
- Consider additional armoring to the bluffs at the southern end of Seaside Avenue
- (see section 2.1)
- Consider development of living shorelines (see section 2.2)

Acquired parcels may be converted into a combination of uplands for constructing a collective septic system and lowland for constructing living shorelines and created marsh migration zones. These will serve to offset compromised existing septic systems in adjacent properties (see section 3.2 for more information on wastewater treatment). This would work in tandem with creating a channel to permit hydrologic connectivity underneath the existing Seaside Avenue roadway alignment to permit future marsh migration. The creation of a living shoreline along the water edge of Chittenden Park may temporarily attenuate impacts to the West River and create an area for future boat mooring to access remaining residents at the end of Seaside Avenue. Cut and fill may be used to create new topography for these living shorelines. Additional armoring along rock outcrops at the southern end of Seaside Avenue is suggested to protect future uses and habitability.

Mitigating Infrastructure

- Consider zoning overlays to reflect alterations to civic and emergency services (see sections 6.2 and 6.3)
- Consider vertical posts along right-of-way for transportation safety (see section 3.1)
- Consider development of alternative transportation to Seaside Avenue-accessed properties (see section 3.1)

As rising water levels and more frequent and persistent flooding events occur, zoning overlays and associated regulatory changes may be developed to reflect limited civic services to residents. The Seaside Avenue road may be flanked with vertical posts with water level indication lines to communicate safe passage to remaining residents. This seasonal passable condition also has implications for provided civic services such as fire protection. Preparations for alternative transportation access to remaining residents on higher ground at the southern

edge of Seaside Avenue may begin by planning for bulkhead investments and increased mooring capacity at a new transportation gateway at the end of Whitfield Street (see "T" on figure 10.) Additionally, the private marina at the end of Pages Lane may be engaged to discuss permitting future public mooring and parking uses.

Stage 2 Zone of Shared Risk Coastal Adaptation Example Plan (Figure 11)

Sea level rise and storm surges with greater frequency and intensity will increasingly impact homes along Seaside Avenue. This will increase risk, limit egress, and compromise infrastructure due to flooding. Seaside Avenue may be transitioned from its current configuration towards a coastally adapted recreational destination with housing and public amenities, new inland development, and a network of living shoreline and restored habitats to proactively address these impending risks.

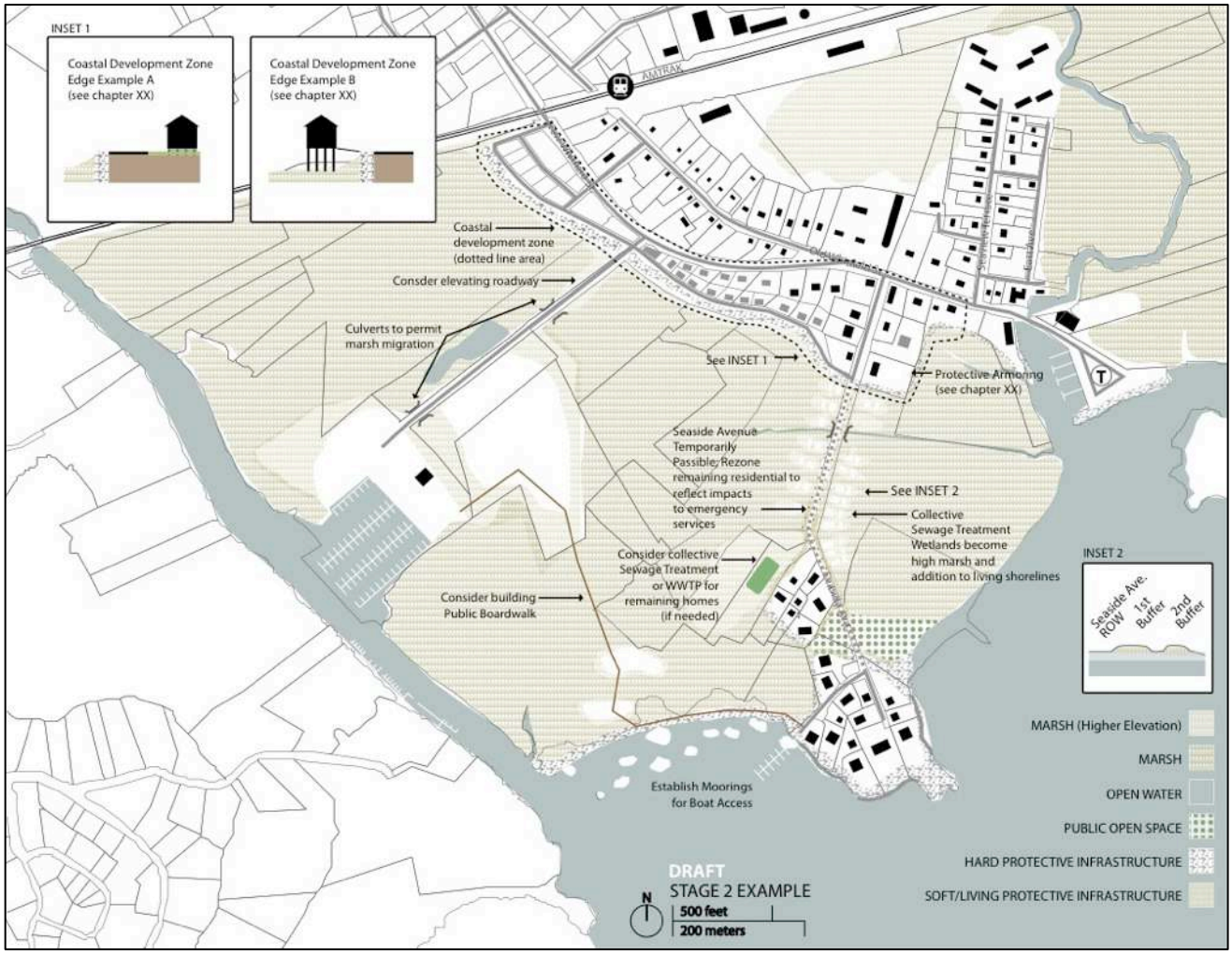


Figure 11
Seaside Avenue Zone of Shared Risk Stage 2 Coastal Adaptation Neighborhood Plan Example

Land Acquisition and Relocation

- Plan for new, coastally-adapted upland development zone along New Whitfield Street to offset properties lost along Seaside Avenue in partnership with private developers (see section 5.0)
- Prepare for transient Seaside Avenue vehicular access; develop zoning overlay to reflect limited provisioning of emergency services (see sections 6.2 and 6.3)

The creation of new development parcels in areas further upland may offset accumulating losses of habitable properties accessed by Seaside Avenue, while landscaped embankments can serve as a buffer for the town. These new development parcels must be constructed with coastal adaptation in mind and may expand existing planning efforts for the Town Center South area of Guilford. Implementation of new zoning overlays that codify limited emergency services due to transient vehicular access on Seaside Avenue may occur in addition to new development.

Having initiated changes to Seaside Avenue, Guilford will be positioning this Zones of Shared Risk for further funding through state and federal sources. Funding for coastal recreational amenities could come from the Small Town Economic Assistance Program (see section 8.4). Funding for implementing living shorelines could come from a variety of sources including FEMA's Pre-Disaster Mitigation Program (see section 8.4).

Protective Infrastructure

- Consider development of armoring along edge of new inland development zone (see section 2.0)

Protective armoring could be constructed along the edge of a new inland development zone along New Whitfield Street as described above. This protective armoring can be a combination of hard revetments and soft, living infrastructure (see inset 1, examples A and B in figure 11). New development along New Whitfield Street should be designed to contribute to the coastally adapted coastline by provisioning areas for marsh advancement in the form of living shorelines.

Mitigating Infrastructure

- Consider development of moorings for boat access to properties at end of Seaside Avenue (see section 3.1)
- Consider construction of public boardwalk (see section 3.0)
- Consider elevation of Pages Lane and installation of culverts (see section 3.1)
- Consider transitioning collective sewage treatment wetlands to high marsh areas in living shorelines (see section 2.2)
- Consider use of Chittenden Park as a new collective sewage treatment area (see section 3.2)
- Consider development of stormwater and wastewater green infrastructure network for new inland development (see section 4.0)

Changing conditions to lands accessed by Seaside Avenue create an opportunity to envision alternative uses. A network of public recreation accessed by a new boardwalk may be constructed by connecting Pages Lane to living shorelines and marsh advancement zones at the edge of Chittenden Park and ultimately to the bluff at the southern end of Seaside Avenue at Rock Point Lane. Moorings for boat access at this location will permit future transportation to this area when Seaside Avenue is no longer accessible. Investments on Pages Lane may permit continued use of this road while enabling marsh advancement zones to connect under it through new culverts. The collective sewage treatment area along Seaside Avenue will eventually be phased out as the road is converted to a public boardwalk, and alternative collective sewage treatment areas will be proposed. A sewage treatment system will be designed for the new inland development area. A robust stormwater network that can serve as a flood control and drainage system during large storm events can be built.

Stage 3 Zone of Shared Risk Coastal Adaptation Example Plan (Figure 12 on the next page)

This stage represents additional responses to the continued advancement of sea level rise and storm surges. The area south of Amtrak could be transitioned to a network of public amenities that traverse islands and are flanked by marsh advancement zones doubling as living shorelines. A new inland "coastally adapted" transit-oriented development zone could make up for lost properties along what was formerly known as Seaside Avenue.

Land Acquisition and Relocation

- Continued development of inland, coastally-adapted transit-oriented development zone (see section 5.0)
- Ecological restoration projects and ongoing maintenance and management of restored ecosystems advancement zones.

The conditions represented in stage 3 promote continued transitioning of habitable parcels from Seaside Avenue to a new coastally adapted inland zone discussed in stage 2. The remaining habitable lands formerly at the southern end of Seaside Avenue may be transitioned to alternative public recreation uses if private residences are no longer sought in this location. Further mixed-use transit-oriented development may begin to occur around the train station supported by a new resident population. Ongoing ecological restoration, maintenance and management programs will be valuable for maintaining the ecological functions of this large estuary and upland area. Funding through the U.S. Army Corp of Engineers, including such as the Section 206/Floodplain Management Services (see section 8.4) could apply.

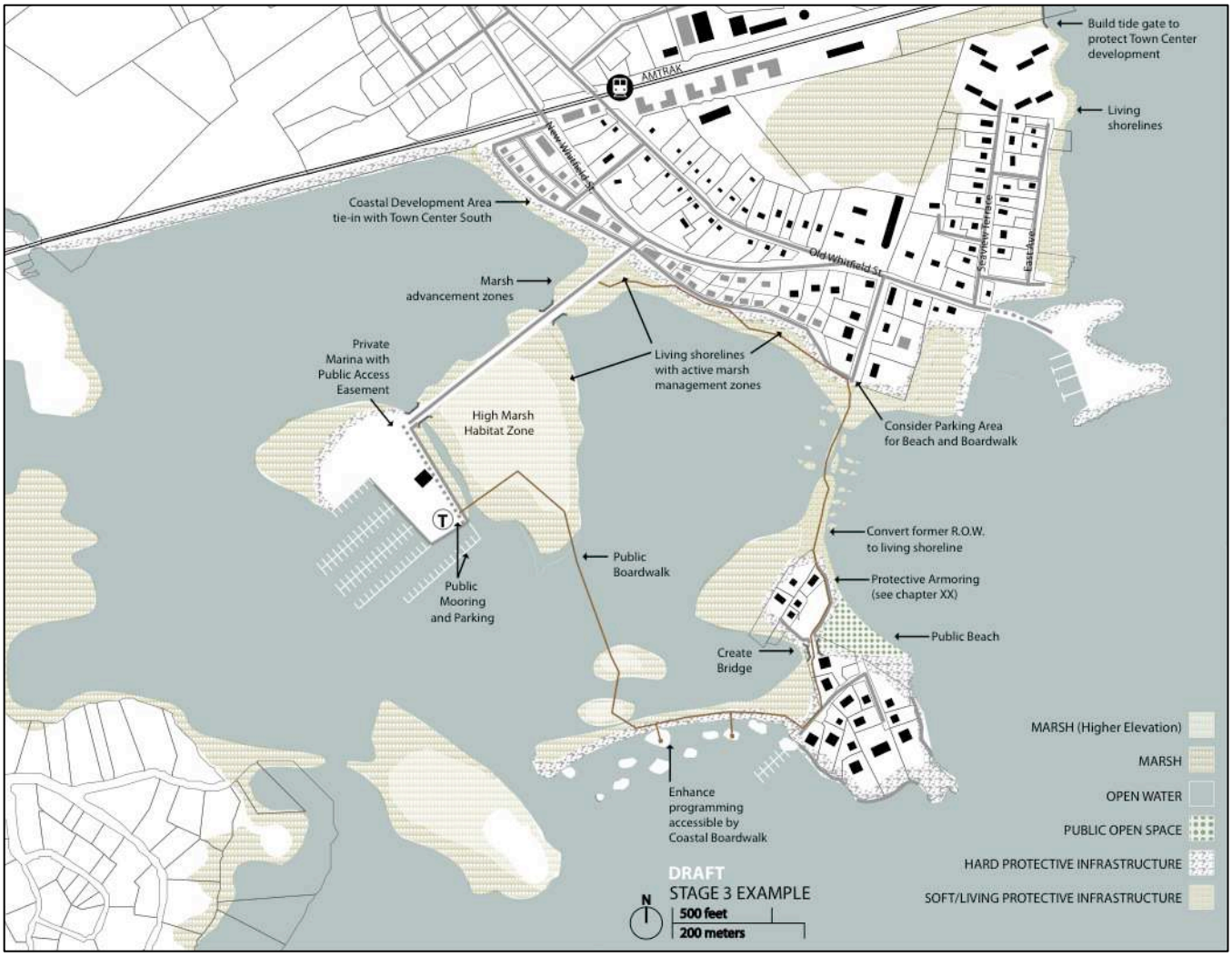


Figure 12
Seaside Island Zone of Shared Risk Stage 3 Coastal Adaptation Neighborhood Plan Example

Protective Infrastructure

- Consider additional protective armoring along island (see section 2.0)
- Consider transitioning Seaside Avenue right-of-way to a living shoreline (see section 2.2)
- Consider development of living shorelines along edge of new inland development zone (see section 2.2)
- Consider development of living shorelines along East Avenue (see section 2.2)
- Consider building tide gate to manage water and prevent TOD flood events near Amtrak and end of Seaview Terrace (see section 3.1)

Additional protective infrastructure should be considered in tandem with the development of new inland development zones. This protective infrastructure may flank the entire habitable area south of the Amtrak train line through a combination of hard (armoring) and soft (living shorelines) infrastructure. A tide gate should be considered at the northern edge of Seaview terrace to prevent inland flooding of the marsh adjacent to the train station and new transit-oriented development zone. The former Seaside Avenue right of way may serve as a foundation for the development of a protective living shoreline.

Mitigating Infrastructure

- Consider creation of public mooring and parking easement at Marina at Pages Lane (see section 3.0)
- Consider creation of bridge to link new islands with boardwalk (see section 3.0)
- Consider establishing marsh advancement zones (see section 4.0)
- Consider relocating Jacob's Beach closer to inland development area and establishing parking area for beach and boardwalk users (see section 3.0)

Additional public mooring and parking at the end of Pages Lane will provide service to the public recreation network established in stage 2. Additional parking may also be considered near the end of Whitfield Street for beach and boardwalk users. The public boardwalk begun in stage 2 may be extended on top of the living shoreline created in the Seaside Avenue right of way to complete a publicly accessible loop flanked by marsh advancement zones. Jacob's beach will be relocated along Seaside Avenue to link it back to the mainland for continued public use.

7.3 Additional Plans for Zones of Shared Risk

Based on the public comments received at the July 15, 2013 meeting, residents of Guilford are interested in neighborhood-scale planning. Appendix B presents a matrix of individual options for adaptation and resilience that would apply to various neighborhoods of Guilford. The first page includes shorefront neighborhoods and the second page includes areas that are inland slightly yet still vulnerable to coastal hazards due to their low-lying elevations or proximity to tidal waters. This matrix can be used when specific neighborhoods begin planning. Alternatively, an integrated process of implementation tailored and co-generated within each zone of shared risk may also be developed and taken. An overview of this approach is provided in Section 8.7 and additional details are provided in appendix E.

8.0 IMPLEMENTATION

8.1 Approach

Implementing the Coastal Resilience Plan will require important changes in the way the Town of Guilford manages land use and development in the coastal area. Above all, public education about the likely changes in the coastal environment and the options recommended in this plan are a critical precursor to the implementation of this Plan's recommendations. Beyond education, it will be important for the town to ensure that the following are considered in the context of implementation: the appropriate Town agency, funding, staff, relationship to State and Federal agencies, and measuring/monitoring of seal level rise and related events.

Ideally, and as described in Section 1.3, implementation is likely to be more effective if it is negotiated with, tailored to and co-generated in partnership with representative participants within the at-risk coastal areas. These areas contain different people with multiple (and at times conflicting) conceptions of problems, goals, interests, and perspectives. Therefore, successful implementation is as much about creating a collective learning process to effectively navigate and unite people and institutions with different perspectives and interests as it is engaging with the evolving challenges and opportunities along the coast.

The Coastal Resilience Plan serves as a guide that will be fine-tuned by engaging with specific communities to adapt the strategies themselves to the context. Identifying the appropriate scales, procedures, and facilitation of this engagement is a critical step in the negotiations and implementation process to ensure challenges are clarified and addressed. Preliminary ideas of where this is appropriate and how to do this are discussed in Section 8.7.

8.2 Education

The primary purpose of this Plan is to educate the town administration and residents about the possible ramifications of sea level rise and increasing storm intensity and frequency on our coastal neighborhoods and resources. The continuing discussion and refinement of the Plan over the years will be its most important contribution to health and well being of the community. Careful monitoring of the "facts on the ground" and public discussion of the implications of these facts will be required.

Addressing the issues of sea level rise as described in this Plan require long term (up to 50 year time horizon) attention. However, the impacts of climate change may have already been experienced and require more immediate attention. The Town should institutionalize an annual review of progress toward addressing the Plan strategies, updating the monitoring of facts on the ground and educating new residents and generations about these coastal issues.

8.3 Tools

This plan is to be approved by the Planning and Zoning Commission and the Board of Selectmen as part of the Plan of Conservation and Development. In doing this, the plan's recommendations

will become official policy of the Town of Guilford. The Coastal Resilience Plan should be updated annually as part of the annual review noted above. Implementation of the strategies in this plan will need to be coordinated by an agency or commission. Two choices are possible:

- **(A)** A new Town body could be created to implement this plan and coordinate its updating. By Town ordinance, a new Commission could be created (e.g."Coastal Resilience" or "Coastal Management" Commission. This new commission would oversee carrying out the plan recommendations by other Town agencies including the Board of Selectmen and the Planning and Zoning Commission; or

- **(B)** This plan could be approved by the Hazard Mitigation Commission that was created by ordinance pursuant to the adoption of the Town of Guilford Hazard Mitigation Plan. Upon approval of the plan by the commission, the Hazard Mitigation Commission would become responsible for implementing this plan. If this option were chosen, either the existing Hazard Mitigation Plan would need to be amended to include this Coastal Resilience Plan, or the ordinance would need to be amended to provide the Hazard Mitigation Commission the authority to oversee the implementation of the Coastal Resilience Plan[4].

The above described new Commission or existing Hazard Mitigation Commission should explore alternatives for institutional arrangements that have the granted authority and resources to implement some of the strategies in this plan. These institutions would require statutory authority to buy and sell property, develop or retire real estate, raise capital, and retain staff. The complex nature of implementing this plan emphasizes the need for the Town to have a vehicle to focus on the important issues such as property and land use as discussed in Chapter 6.

Four alternatives for these institutional arrangements for the Town to consider are:

- **(1)** The Town could function as a development agency, with appropriate staffing for oversight. Current precedents for this model include overseeing modifications to town-owned property along Pages Lane, on Bluff Head, and in the East River Preserve. Multiple methods for how the Town may proceed with property acquisition are listed in Table 6 in Chapter 6.0. Ultimate statutory authority for acquisition would require approval by Town Meeting. Additional guidelines and opportunities regarding this Town-based development agency approach can be found within Connecticut General Statutes Chapter 130 Sec. 8-124 and Sec. 8-126 as well as Chapter 132 Sec. 8-186.

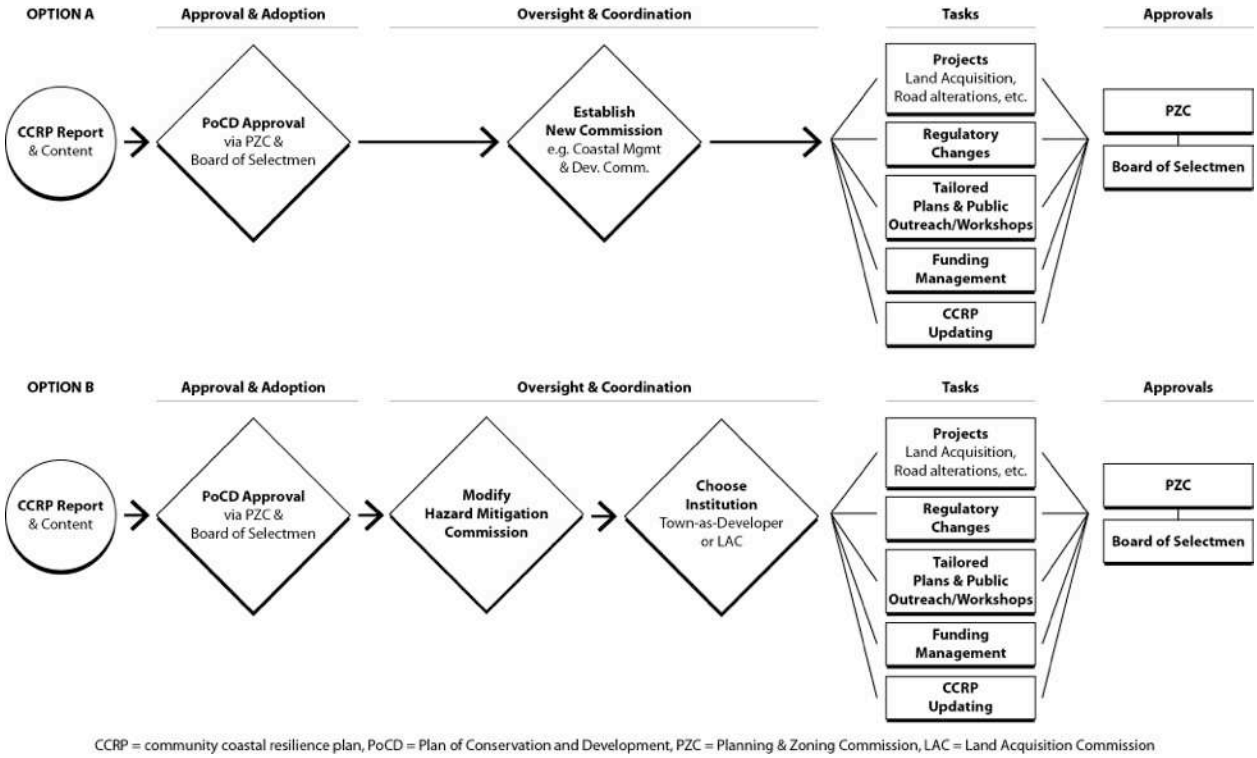
- **(2)** The possible creation of a newly formed Commission or agency to determine and recommend to the Board of Selectmen about the acquisition of any of the four types of properties listed in Chapter 6.0. Charge and duties for this newly formed commission or agency would be similar to the existing Land Acquisition Commission, although explicitly focused on affected lands as described in Chapter 6.0. Its composition may also have representation among property owners of affected lands. Multiple methods for how this commission or agency may recommend proceeding with property acquisition are listed in Table 6 in Chapter 6.0. This

[4] Refer to Chapter 12.0, "Plan Implementation" from the Hazard Mitigation Plan for more information.

institution may also be formed as a quasi-public agency, enabling relatively fast action regarding acquisition matters. In any case, ultimate statutory authority for the acquisition of property would reside with the Town and require approval by Town Meeting.

- **(3)** Expand the responsibilities of the existing Land Acquisition Commission to include making recommendations to the Board of Selectmen regarding the acquisition of the four types of properties listed in Chapter 5.0. Tasking the existing Land Acquisition Commission with these responsibilities falls within their existing charge and duties. Ultimate statutory authority for the acquisition of property would reside with the Town and require approval by Town Meeting.

- **(4)** Alternatively or additionally to these three options, the possible creation of a body with the powers to buy and sell property, develop or retire real estate, and raise capital could be created on a regional or multi-town level. However, surrounding communities such as Branford and Madison have not yet been contacted regarding this type of arrangement, and existing statutory requirements would still apply.



CCRP = community coastal resilience plan, PoCD = Plan of Conservation and Development, PZC = Planning & Zoning Commission, LAC = Land Acquisition Commission

Figure 13
Options for CCRP Approval, Implementation Oversight, and Ongoing Tasks

- Management of Coastal Real Estate and Structures – Zoning amendments, zoning overlays, and strengthening of buildings codes through zoning are all strategies that can be directly conveyed to the Planning and Zoning Commission from the new coastal commission or Hazard Mitigation Commission. The two commissions would work together to ensure that these modifications are effective in building coastal resilience. The acquisition of damaged properties can occur through two mechanisms. If acquisitions are cost-effective (per the FEMA benefit-cost analysis) then the Board of Selectman would need to represent the town as the sub-applicant to the State of Connecticut. If acquisitions are to be pursued without FEMA mitigation funds, then a new coastal commission would be involved. In all cases, the strategies would contribute to coastal realignment over the long term.

- Shoreline Protection and Management of Coastal and Near-Shore Lands – For hard shoreline protections and living shoreline projects, the Hazard Mitigation Commission will work with the Town Engineer and the Harbor Management Commission. Creation of buffers can occur in connection with shoreline protections and living shorelines, or through setbacks, and therefore the Hazard Mitigation Commission may work with the Conservation Commission and Planning and Zoning Commission, Land Acquisition Commission or the Town Engineer. Land acquisitions can be facilitated by the Hazard Mitigation Commission working with any number of entities that are authorized to acquire land (Land Acquisition Commission, local land trusts, a new coastal commission, or The Nature Conservancy). In contrast, land that is already being conserved could be addressed by the Hazard Mitigation Commission working with the owners, the Conservation Commission and the Planning and Zoning Commission, or the Conservation Commission with local land trusts or The Nature Conservancy.

- Roads and Roadway Alterations – Most of the roadway strategies will be addressed directly by the Hazard Mitigation Commission working with the Town Engineer. However, if establishment of alternate egress is desired, this may require land acquisition, and a new coastal commission could be involved.

- Protection or Replacement of Water Supply Wells and Septic Systems – Similar to the roadway strategies, all of these strategies would involve the Hazard Mitigation Commission working with the Town Engineer, but in this case the Health Department would be involved as well. The property abandonment "strategy" could possibly result on its own when wells and septic systems are no longer viable, but a new coastal commission could work with the Town Engineer and Health Department to acquire these properties in advance.

As this plan is revised, these approaches may need to be modified to reflect prevailing policies.

In the short term, the Coastal Management and Development Commission or Hazard Mitigation Commission will be supported by existing municipal staff in the Planning Department as well as the Town Engineer and Health Department. In the long term, additional staff may be warranted. Future updates to this plan will continue to address staffing.

8.4 Funding Sources

Small Town Economic Assistance Program (STEAP)

The STEAP funds economic development, community conservation and quality of life projects for localities that are ineligible to receive Urban Action bonds. This program is administered by the Connecticut Office of Policy and Management. Towns may receive up to $500,000 per year if they are not designated as a distressed municipality or a public investment community, and the State Plan of Conservation and Development does not show them as having a regional center. Guilford meets these requirements for eligibility and has used the program in the past for renovation of Jacobs Beach. Projects eligible for STEAP funds include:

The Jacobs Beach improvements were funded in part by a STEAP grant

- economic development projects such as (a) constructing or rehabilitating commercial, industrial, or mixed-use structures and (b) constructing, reconstructing, or repairing roads, access ways, and other site improvements;
- recreation and solid waste disposal projects;
- social service-related projects, including day care centers, elderly centers, domestic violence and emergency homeless shelters, multi-purpose human resource centers, and food distribution facilities;
- housing projects;
- pilot historic preservation and redevelopment programs that leverage private funds; and
- other kinds of development projects involving economic and community development, transportation, environmental protection, public safety, children and families and social service programs.

While STEAP funds are not typically known for uses related to hazard mitigation or coastal adaptation, the program should be considered in the future to help fund the less-costly adaptation strategies pursued by Guilford. The following projects were funded in the last few years and serve as appropriate examples that are consistent with some of the adaptation measures discussed in this plan:

- Construction and installation of off-site wastewater disposal and sewer service
- Public water line extension
- Rehabilitation or replacement of a town bridge
- Replacement of bulkheads
- Roadway improvements
- Construction of a public works garage
- Construction/installation of a new water supply well
- Drainage improvements
- Construct roadway approaches to a bridge

FEMA Funding

- *Pre-Disaster Mitigation Program* – The Pre-Disaster Mitigation program was authorized by Part 203 of the Robert T. Stafford Disaster Assistance and Emergency Relief Act (Stafford Act). The Pre-Disaster Mitigation program provides funds to states, territories, tribal governments, communities, and universities for hazard mitigation planning and implementation of mitigation projects prior to disasters, providing an opportunity to reduce the nation's disaster losses through pre-disaster mitigation planning and the implementation of feasible, effective, and cost-efficient mitigation measures. The Pre-Disaster Mitigation program is one of the FEMA programs with the most potential fit to potential projects in Guilford, with the other being HMGP (described below). After two years without support, Congress reauthorized the Pre-Disaster Mitigation Program at a lower level of funding and FEMA is administering Pre-Disaster Mitigation in 2013. The Department of Emergency Services and Public Protection will be administering it going forward from 2013. It is possible that some of the adaptation projects in Guilford could be funded if PDM is supported and if the projects meet FEMA's requirement of cost effectiveness.

The PDM program funded the Guilford Hazard Mitigation Plan.

- *Hazard Mitigation Grant Program* – The Hazard Mitigation Grant Program is authorized under Section 404 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act. The Hazard Mitigation Grant Program provides grants to states and local governments to implement long-term hazard mitigation measures after a major disaster declaration. The purpose of the Hazard Mitigation Grant Program is to reduce the loss of life and property due to natural disasters and to enable mitigation measures to be implemented during the immediate recovery from a disaster. A key purpose of the Hazard Mitigation Grant Program is to ensure that any opportunities to take critical mitigation measures to protect life and property from future disasters are not "lost" during the recovery and reconstruction process following a disaster. The Hazard Mitigation Grant Program is one of the FEMA programs with the greatest potential fit to potential projects in Guilford. However, it is available only in the months subsequent to a federal disaster declaration in Connecticut. Because the Department of Emergency Services and Public Protection administers the Hazard Mitigation Grant Program directly, application cycles will need to be closely monitored after disasters are declared. It is possible that some of the Guilford adaptation projects could be funded if they meet FEMA's requirement of cost effectiveness.

As of July 2013, more than $20 million was available in Connecticut for mitigation projects to be funded under HMGP.

- *Flood Mitigation Assistance Program* – The Flood Mitigation Assistance program was created as part of the National Flood Insurance Reform Act of 1994 with the goal of reducing or eliminating claims under the National Flood Insurance Program. FEMA provides Flood Mitigation Assistance funds to assist states and communities with implementing measures that reduce or eliminate the long-term risk of flood damage to buildings, homes, and other structures insurable under the National Flood Insurance Program. The long-term goal of

Flood Mitigation Assistance is to reduce or eliminate claims under the National Flood Insurance Program through mitigation activities. The National Flood Insurance Program provides the funding for the Flood Mitigation Assistance program. One limitation of the Flood Mitigation Assistance program is that it is generally used to provide mitigation for structures that are insured or located in Special Flood Hazard Areas. Use of the Flood Mitigation Assistance program in Guilford would be contingent on demonstrating cost-effectiveness and the reduction of flood risks and flood insurance claims.

The Biggert-Waters Flood Insurance Reform Act of 2012 eliminated the two formerly separate FEMA mitigation programs – the Repetitive Flood Claims and Severe Repetitive Loss programs – and made significant changes to the Flood Mitigation Assistance program while incorporating them into Flood Mitigation Assistance.

One potentially important (yet untested) change to the Pre-Disaster Mitigation, Hazard Mitigation Grant Program, and Flood Mitigation Assistance programs is that *"green open space and riparian area benefits can now be included in the project benefit-cost ratio once the project benefit-cost ratio reaches 0.75 or greater. The inclusion of environmental benefits in the project benefit-cost ratio is limited to acquisition-related activities."*[5] This may be an important consideration in Guilford where environmental benefits can be demonstrated.

[5] Refer to the HMA Guidance issued July 2013

U.S. Army Corps of Engineers Funding

The U.S. Army Corps of Engineers provides 100% funding for floodplain management planning and technical assistance to states and local governments under several flood control acts and the Floodplain Management Services Program (FPMS). Specific programs used by the Corps for mitigation are listed below.

- *Section 205 – Small Flood Damage Reduction Projects* – This section of the 1948 Flood Control Act authorizes the Corps to study, design, and construct small flood control projects in partnership with non-Federal government agencies. Feasibility studies are 100% federally-funded up to $100,000, with additional costs shared equally. Costs for preparation of plans and construction are funded 65% with a 35% non-federal match. In certain cases, the non-Federal share for construction could be as high as 50%. The maximum federal expenditure for any project is $7 million.

- *Section 14 – Emergency Streambank and Shoreline Protection* – This section of the 1946 Flood Control Act authorizes the Corps to construct emergency shoreline and streambank protection works to protect public facilities such as bridges, roads, public buildings, sewage treatment plants, water wells, and non-profit public facilities such as churches, hospitals, and schools. Cost sharing is similar to Section 205 projects above. The maximum federal expenditure for any project is $1.5 million.

- *Section 206 – Floodplain Management Services* – This section of the 1960 Flood Control Act, as amended, authorizes the Corps to provide a full range of technical services and planning guidance necessary to support effective floodplain management. General technical assistance efforts include determining the following: site-specific data on obstructions to flood flows, flood formation, and timing; flood depths, stages, or floodwater velocities; the extent, duration, and frequency of flooding; information on natural and cultural floodplain resources; and flood loss potentials before and after the use of floodplain management measures. Types of studies conducted under FPMS include floodplain delineation, dam failure, hurricane evacuation, flood warning, floodway, flood damage reduction, stormwater management, flood proofing, and inventories of flood prone structures. When funding is available, this work is 100% federally funded.

In addition, the Corps also provides emergency flood assistance (under Public Law 84-99) after local and state funding has been used. This assistance can be used for both flood response and post-flood response. Corps assistance is limited to the preservation of life and improved property; direct assistance to individual homeowners or businesses is not permitted. In addition, the Corps can loan or issue supplies and equipment once local sources are exhausted during emergencies.

Special Programs

Guilford will need to watch for special opportunities for funding. Examples include the NOAA grant that funded this

NOAA funded this Coastal Resilience Plan through the Gulf of Maine Council.

coastal resilience plan (application in 2011), the FEMA Resilience Grant (application in 2012), and the Rebuild By Design Competition (application in 2013). Guilford applied for a FEMA Resilience Grant and was not selected. More recently, Guilford was included as a potential pilot community in a proposal submitted to the Rebuild By Design Competition.

The Connecticut Community Recovery Resource Guide and Hurricane Sandy Supplement

The *Connecticut Community Recovery Resource Guide and Hurricane Sandy Supplement* was compiled by FEMA to provide information on more than 1,000 sources of funding or technical assistance that can be used by Connecticut communities, especially those facing the rebuilding of neighborhoods, business districts, and community facilities following a severe weather event or other disaster. The *Community Recovery Resource Guide* is an introduction of basic information about the myriad number of programs available to communities and organizations; it is a starting point for researchers, grant writers, and decision makers. Most of the programs presented in the *Guide* are ongoing, without regard to the period following a Disaster Declaration. The *Hurricane Sandy Supplement* to the Guide speaks directly to the programs offered in response to Hurricane Sandy.

The introductory material associated with the *Connecticut Community Recovery Resource Guide and Hurricane Sandy Supplement* can be found in Appendix D. The full documentation can be obtained from FEMA at http://www.fema.gov/library/viewRecord.do?id=7757. As this document is migrated to a different FEMA-hosted url, a simple internet search may be required to locate it.

8.5 State and Federal Agencies

As discussed in Section 2.2, the Connecticut General Assembly passed Public Act 12-101 in 2012, An Act Concerning the Coastal Management Act and Shoreline Flood and Erosion Control Structures. The Act combined a number of initiatives to address sea level rise and revise the regulatory procedures for shoreline protection. In additional to enabling DEEP to establish a pilot program to encourage "innovative and low-impact approaches to shoreline protection and adaptation to a rise in sea level," the Act recognized sea level rise as an appropriate consideration in coastal zone planning. For the first time, the concept of sea level rise was incorporated into the Connecticut Coastal Management Act (CMA) relative to the general goals and policies of coastal planning. In particular, CGS section 22a-92(a)(5) lists the following goal:

"To consider in the planning process the potential impact of a rise in sea level, coastal flooding and erosion patterns on coastal development so as to minimize damage to and destruction of life and property and minimize the necessity of public expenditure and shoreline armoring to protect future new development from such hazards."

However, the State has been busy with a variety of related efforts. Also in 2012, a bipartisan task force was formed to study and make legislative recommendations on storm impacts on shoreline homeowners and businesses. The task force was charged with looking at the impact

of climate change on efforts to preserve shoreline communities. The task force was asked to make recommendations for legislation to:

- Assist those rebuilding and recovering from the 2011 storms (primarily Tropical Storm Irene, but including October storm Alfred);
- Develop new policies to address the needs of shoreline and waterfront residents and businesses regarding shoreline erosion, rising sea levels, and future storm planning; and
- Ensure that these policies complement existing laws regarding emergency communications between towns and the state, utility company preparedness, response and accountability, and insurance issues.

The task force held public hearings on July 9, 2012 in Branford; July 23, 2012 in Fairfield; and August 6, 2012 in Groton. The task force issued a wide range of recommendations regarding the DEEP regulatory programs, coastal structures, municipalities and land use, insurance and real estate, climate change and sea level rise, and education, among other things. It is expected that some of these recommendations will be addressed in the coming years, helping to build capabilities at the state and municipal levels to increase hazard mitigation.

Pursuant to Special Act 13-9 passed in 2013, "An Act Concerning Climate Change and Data Collection," the State of Connecticut will be establishing a "Center for Coasts" that will conduct research, analysis, design, outreach and education projects to guide the development and implementation of technologies, methods and policies that increase the protection of ecosystems, coastal properties and other lands and attributes of the state that are subject to the effects of rising sea levels and natural hazards. Specifically, the Connecticut Center for Coasts will undertake the following activities:

- Mapping exercises to assess and visualize key characteristics of shoreline resiliency, such as shoreline changes,
- Pilot-scale engineering and impact assessment studies,
- Consensus building efforts to determine state-wide uniform guidelines for planning and development purposes, including the expected rate of sea level rise for the next 100 years,
- Ways to develop state-wide, science-based planning and management alternatives,
- Development in science and information-based outreach and technology transfer programs for state and local agencies and officials involved in planning and development,
- An assessment of soft shore protection strategies in Long Island Sound and the development of instructional guides for the use of such soft shore protection strategies,
- A comprehensive coastal infrastructure inventory and risk assessment,
- An analysis of the impact of seawalls in urban and rural communities,
- The development of uniform, state-wide models that predict inundation flood scenarios under slow, constant sea level rise and under storm surges,
- Projects that lead to the development of rapid storm damage assessment technology,
- Developing design guidelines for the construction and repair of structural and non-structural shore protection, and

- Developing tools for determining appropriate shore protection strategies and providing coastal protection information to a diverse range of end users.

The DEEP Office of Planning and Program Development and Office of Long Island Sound Programs will be partnering with the University of Connecticut to pursue the Center for Coasts. DEEP and the University will deliver a work plan to the Connecticut General Assembly by early 2014.

Likewise, federal agencies have embraced sea level rise and coastal resilience concepts. In particular, NOAA and FEMA are doing the most work and outreach in these areas. For example, NOAA has developed a large inventory of resources for developing adaptation plans, and some of these were utilized by Guilford; and FEMA fast-tracked its advisory flood elevation maps for New York City after Hurricane Sandy in an effort to aid and inform rebuilding, stepping outside its typically longer process for unveiling new regulatory products.

The time is ideal for Guilford to leverage the recent State and Federal interest in coastal resilience by pursuing permits, approvals, and funding for strategies presented in this plan. While there are no guarantees for permits, approvals, and funding from State and Federal agencies, the tools are becoming available for Guilford to work creatively with these agencies to increase resilience.

8.6 Measuring and Monitoring

Measuring coastal storm damage and monitoring of seal level rise are viewed by the town as key strategies to support the implementation of this plan. Over time, State and Federal agencies have made this easier. For example, the USGS hosts a Hurricane Sandy web page with a tool to view inundation caused by the storm surge. The tool includes specific information such as the confirmed and verified water elevation along Seaside Avenue.

There are two ways that Guilford should measure and monitor. First, the town should pursue its own monitoring equipment, possibly funded by FEMA mitigation funds, to monitor sea level rise[6]. Second, the town should work with the new Center for Coasts (when established) to participate in the monitoring efforts that are anticipated by DEEP and the Office of Long Island Sound Programs.

8.7 Continued Public Involvement

Numerous opportunities for public involvement have nee provided during the development of the RISK AND VULNERABILITY ASSESSMENT REPORT, REPORT OF OPTIONS TO INCREASE COASTAL RESILIENCE, and this plan. Public meetings were held in 2012 and 2013, and documents have been posted to the town's web site.

[6] The Town of Greenwich has reportedly received FEMA funding to offset the cost of installing monitoring equipment in Long Island Sound.

Continued public involvement is anticipated by the town. When this plan is adopted in the first quarter of 2014, the public will have an opportunity to ask additional questions or offer ideas for plan implementation. When specific proposals are advanced to the Conservation Commission, Planning and Zoning Commission, and Board of Selectmen, then the public will have additional opportunities to be involved with the crafting of adaptation and resilience. An outline of how this collective learning process in partnership with the public may proceed is visualized in Figure 14 and explained in more detail in Appendix E. Finally, as this plan is updated over the years, additional public involvement will be sought.

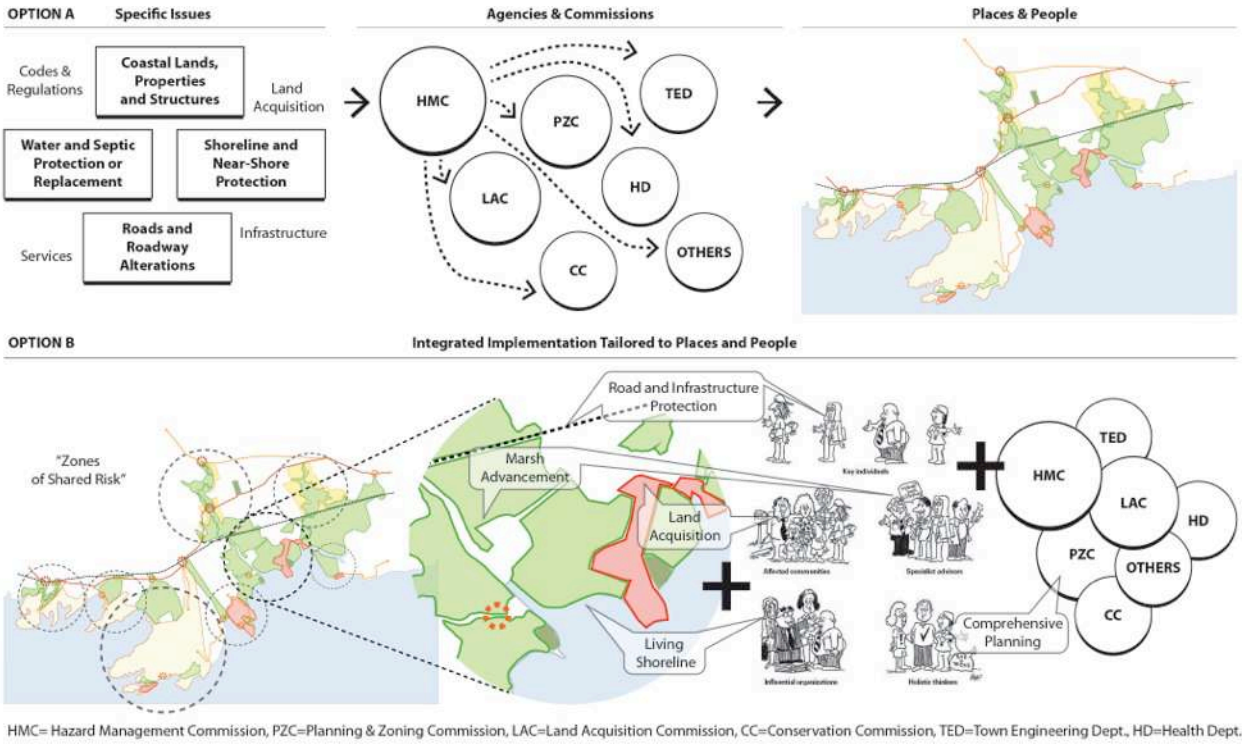


Figure 14
Options for Implementation: Specific Issues vs. Integrated Implementation

Appendix A
Presentation of July 15, 2013

Town of Guilford Coastal Resilience Plan

Project Update and Presentation of Progress toward the Draft Plan

July 15, 2013





Presented by:
George Kral, Town Planner
David Murphy, P.E., CFM, Milone & MacBroom, Inc
Alexander Felson, PhD, Yale Urban Ecology and Design Lab

The Nature Conservancy
Protecting nature. Preserving life.™

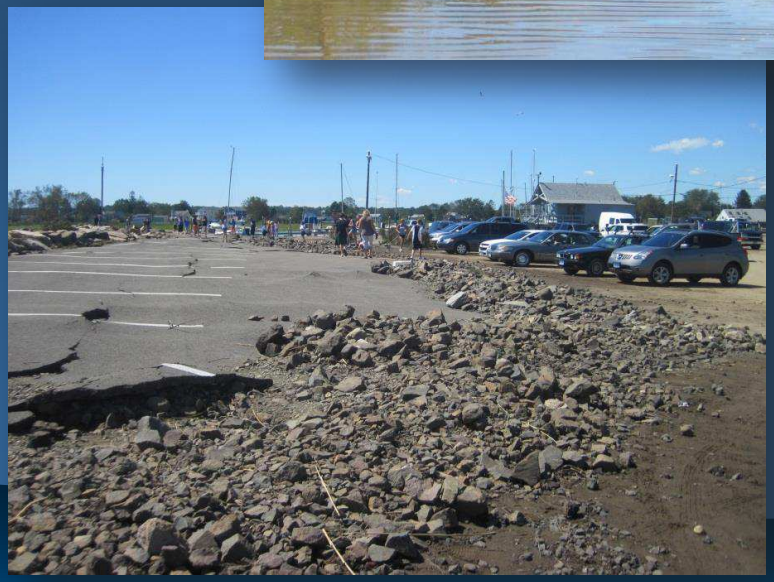
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Presentation Agenda

- Work Completed to Date
- Review of Projected Daily Inundation and Storm Surges
- Shared Risk Concepts
- Adaptation Options
- Neighborhood Plan Examples
- Next Steps
- How to Stay Involved





The Town of Guilford
Connecticut, USA Founded 1639

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Work Completed to Date

The four basic steps of Guilford's Coastal Resilience Program have been largely completed:

1. Generate awareness of coastal risk (2011 through today)
2. Assess coastal risks and opportunities (2012)
3. Identify choices for addressing priority risks and vulnerabilities (2012 and 2013)
4. Develop an action plan to put selected choices into place (2013 and ongoing)

Implementation will happen going forward from today

What is Vulnerable and What is at Risk?

- Social
- Economic
- Infrastructure
- Utilities
- Emergency Services
- Natural Systems







Review Projected Daily Inundation & Storm Surges

- The vulnerability assessment relied on sea level rise projections generated under contract between The Nature Conservancy and Columbia University's Earth Institute/NASA Goddard Institute for Space Studies in 2010-2011

Scenarios	2020	2050	2080
Conservative	3.5 inches	10 inches	18.5 inches
Medium	3.5 inches	10 inches	20 inches
High	9 inches	26 inches	52 inches

Review Projected Daily Inundation & Storm Surges

- 2020s: scenarios mapped by the coastal resilience viewer

Decade	Condition	Sea Level Rise Estimates*	Elevation (feet, NAVD)
2020s	No Storm	High	3.7
		Medium	3.3
		Conservative	3.3
	Category 2	High	9.8
		Medium	9.4
		Conservative	9.4
	Category 3	High	12.8
		Medium	12.4
		Conservative	12.4

Source: TNC (www.coastalresilience.org)

Review Projected Daily Inundation & Storm Surges

- 2080s: scenarios mapped by the coastal resilience viewer

Decade	Condition	Sea Level Rise Estimates*	Elevation (feet, NAVD)
2080s	No Storm	High	7.3
		Medium	4.7
		Conservative	4.5
	Category 2	High	13.4
		Medium	10.8
		Conservative	10.6
	Category 3	High	16.4
		Medium	13.8
		Conservative	13.6

Source: TNC (www.coastalresilience.org)

Review Projected Daily Inundation & Storm Surges

- NOAA recently updated sea level rise projections (December 2012)
- Some recent projections have caused concern
- While projections will improve over time, we know that coastal hazards are already occurring
- The appropriate time for planning is now
- The range of change (based on the best science we have access to) may need to be addressed later

How Projections Affect Plan Implementation

- Therefore:
  - ✓ Flexibility should be built into the plan and the town's institutional knowledge so if conditions change for the worse, Guilford is not starting from scratch
  - ✓ The plan will take a staged approach that responds to changing conditions
  - ✓ Do not try to do everything at once
  - ✓ The plan will be designed to be adaptable as more information becomes available

Shared Risk Concepts

- Risks are shared across Guilford, although they may vary by neighborhood
- Some shared risks are repeated spatially – for example, vulnerable wells and septic systems can be found in several areas, so many residents "share" the risk
- Some shared risks are truly shared – for example, many coastal neighborhoods rely on Route 146 at the same time

Shared Risk Concepts

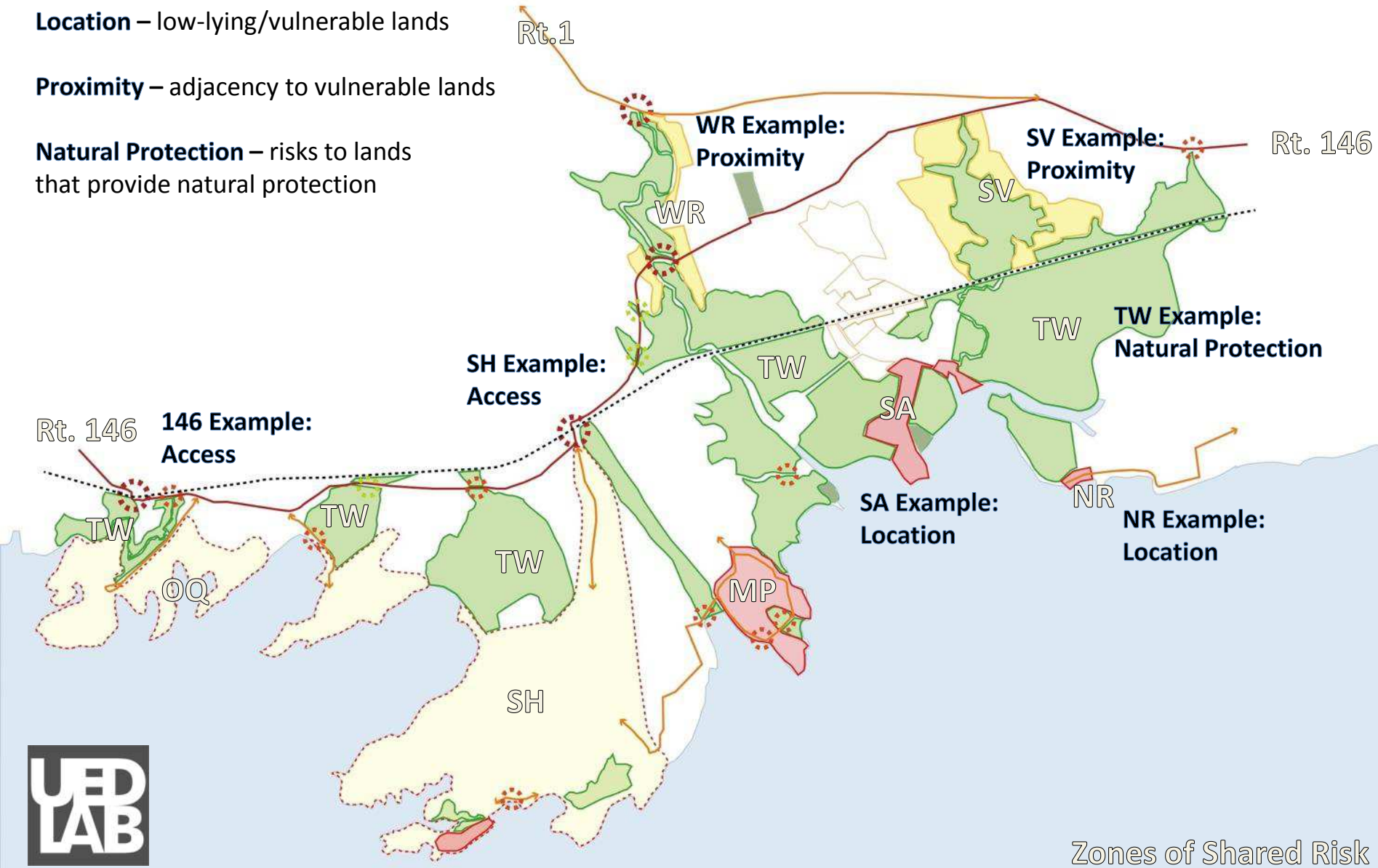
Zones of Shared Risk Types:

Access – ability to enter/exit area

Location – low-lying/vulnerable lands

Proximity – adjacency to vulnerable lands

Natural Protection – risks to lands that provide natural protection



Shared Risk Concepts

TW – Tidal Wetlands
OQ – Old Quarry
SH – Sachem's Head
WR – West River
MP – Mulberry Point
SA – Seaside Avenue
SV – Soundview Road
NR – Neck Road



At-risk Access Zones

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Zones of Shared Risk

Options for Adaptation in Guilford

Option	Typical Actions
1. Management of coastal real estate and structures	May include phasing with coastal realignment strategies and may occur through zoning overlay districts or zoning amendments; May include strengthening building codes to require freeboard, using V zone standards in A zones, and acquisition of property damaged by coastal hazards.
2. Shoreline protection and management of coastal and near-shore lands	May include hard shoreline protections, living shorelines, land acquisition and land conservation practices for tidal marsh advancement, and tidal wetland buffers for near-shore flood protection.
3. Roadway alterations	May include elevation of roadways, abandonment of some roads, re-analysis of emergency access, and developing alternative egress for some areas.
4. Protection or replacement of water supply wells and septic systems	May include on-site retrofits, development of community systems, extension of sewer and water systems, or vacating properties.

Options for Adaptation in Guilford

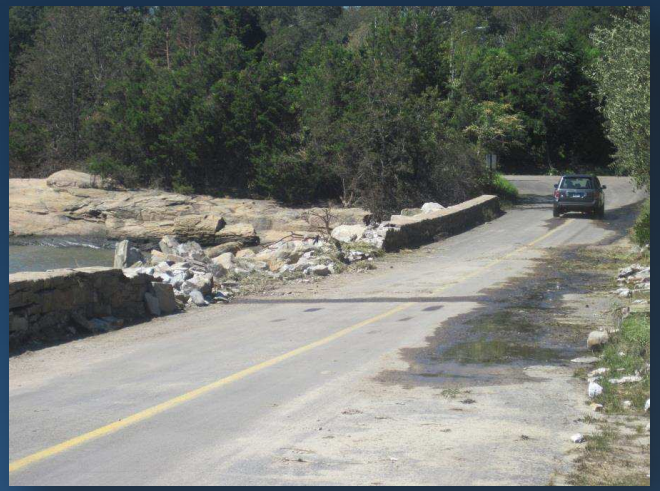
- For implementation, these have been organized as follows:
  - ✓ Protective Infrastructure
  - ✓ Community Infrastructure
  - ✓ Regulatory Tools
  - ✓ Natural Resources protection
  - ✓ Property Acquisitions
  - ✓ Implementation Tools

Options for Adaptation in Guilford

- Protective Infrastructure
  - ✓ Hard shoreline protection
  - ✓ Living shorelines
  - ✓ Using buffers for protection



Living shoreline from "Comprehensive Strategy for Reducing Vulnerability to Climate Change," Maryland Commission on Climate Change





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Options for Adaptation in Guilford

- Community Infrastructure
  - ✓ Roads
  - ✓ Water Supply Wells
  - ✓ Wastewater Disposal Systems



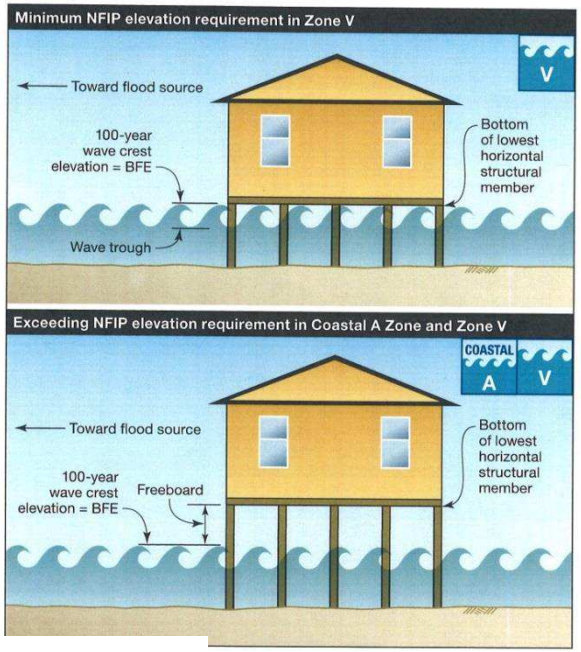


Elevated septic system from "Rolling Easements," EPA



Options for Adaptation in Guilford

- Regulatory Tools
  - ✓ Building Codes
  - ✓ Zoning Regulation Amendments
  - ✓ Overlay Zones
  - ✓ Setbacks to accommodate marsh advancement



lings in Coastal A Zone and Zone V compared to minimum

5.3 Specific Standards

In all special flood hazard areas A and AE, where base flood elevation data has been provided, the following provisions shall apply in addition to all general standards contained in Section 5. 1.

5.3.1 Residential construction

New construction or substantial improvement of any residential structure shall have the lowest floor, including basement, elevated at least one foot above the base flood elevation.

Section of revised Zoning Regulations for Old Saybrook

Options for Adaptation in Guilford

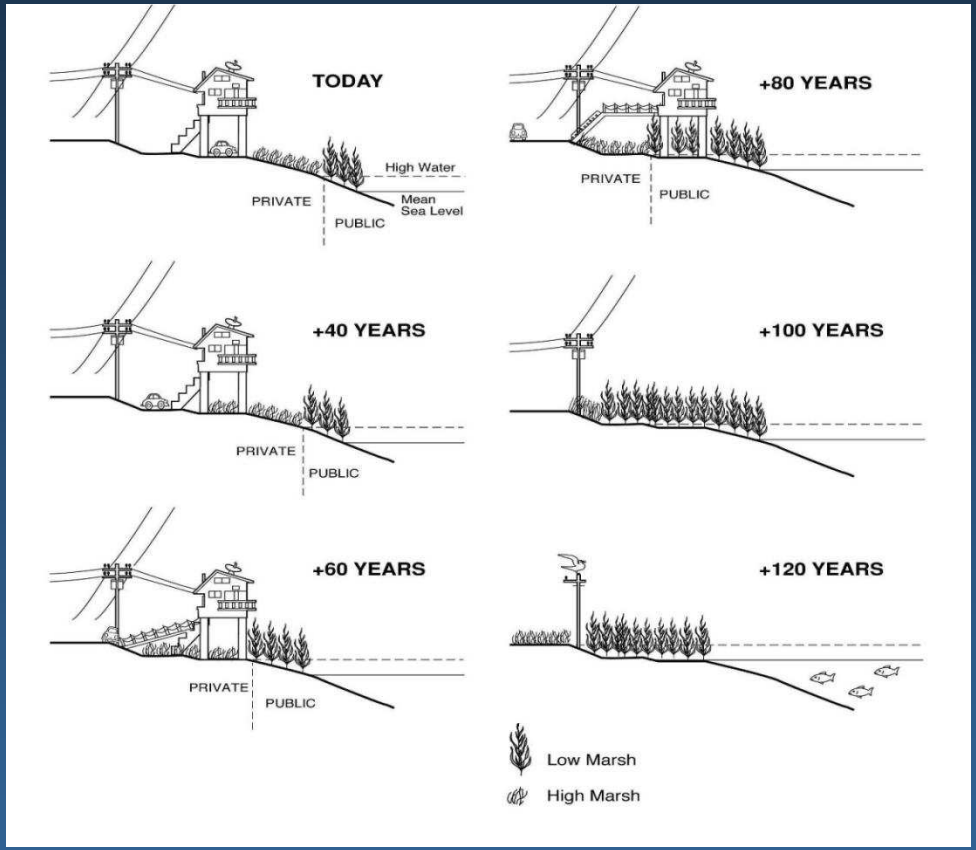
- Natural Resource Protection
  - ✓ Land acquisition for tidal marsh advancement
  - ✓ Land conservation for tidal marsh advancement





Options for Adaptation in Guilford

- Property Acquisitions
  - ✓ Vacant or occupied, for tidal marsh advancement
  - ✓ Storm-damaged properties, to prevent future damage
  - ✓ To allow shoreline realignment



Options for Adaptation in Guilford

- Implementation Tools
  - ✓ Commission or Committee administration
  - ✓ Funding and staff
  - ✓ Potential need for a development authority
  - ✓ Interaction with State and Federal Agencies
  - ✓ Monitoring, measuring, and tracking sea level rise and storm damage
  - ✓ Maintaining and updating the coastal resilience plan to keep up with actual sea level rise or new projections
  - ✓ Continued public education
  - ✓ Integrate with POCD, hazard mitigation plan update, economic development, and other plans

Neighborhood Plan Examples

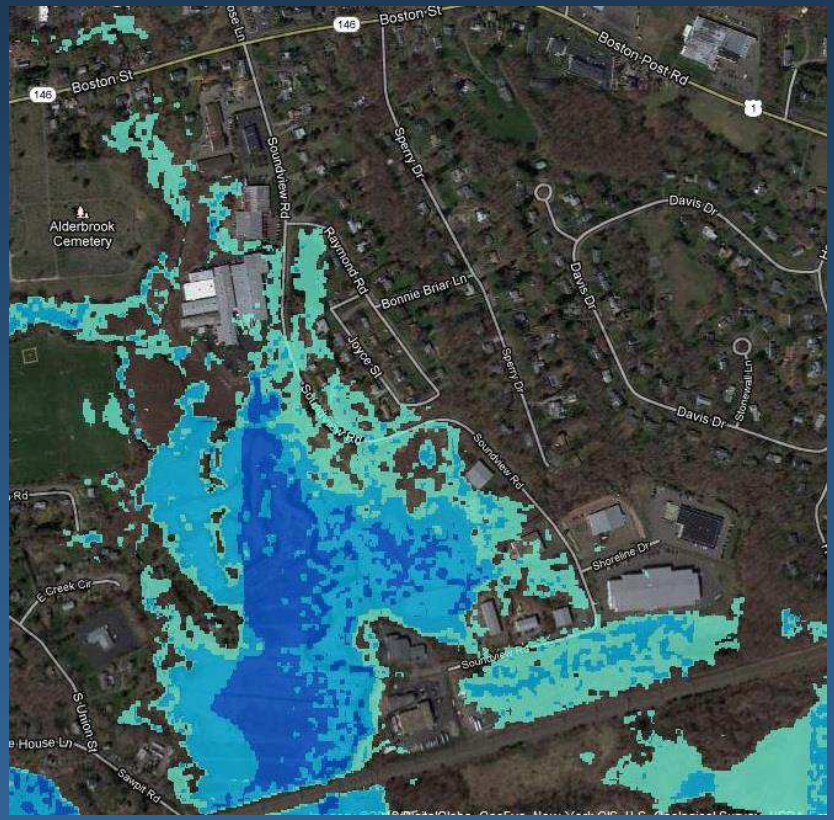
- Objective is to showcase possible inundation/surge scenarios and adaptation outcomes for two types of neighborhoods:

  - ✓ **Soundview Road** was selected to consider commercial and industrial land uses and demonstrate tradeoffs in zones of shared risk

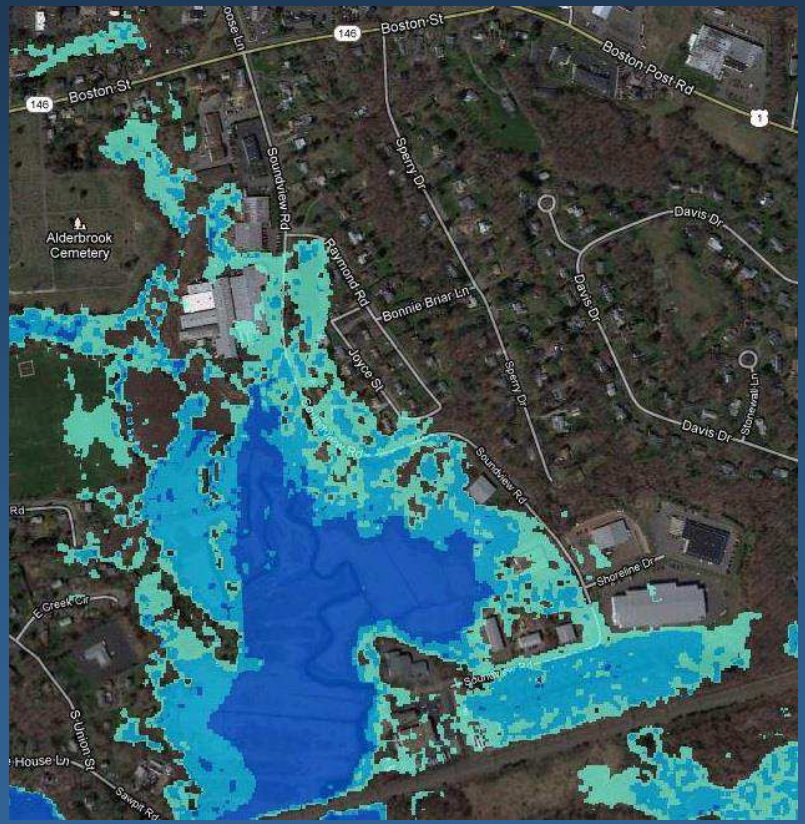
  - ✓ **Seaside Avenue** was selected to consider residential and municipal land uses and demonstrate future outcomes in zones of shared risk

Neighborhood Plan Example – Soundview Road

- Scenarios that informed the Soundview Road plan



2020s Daily Inundation



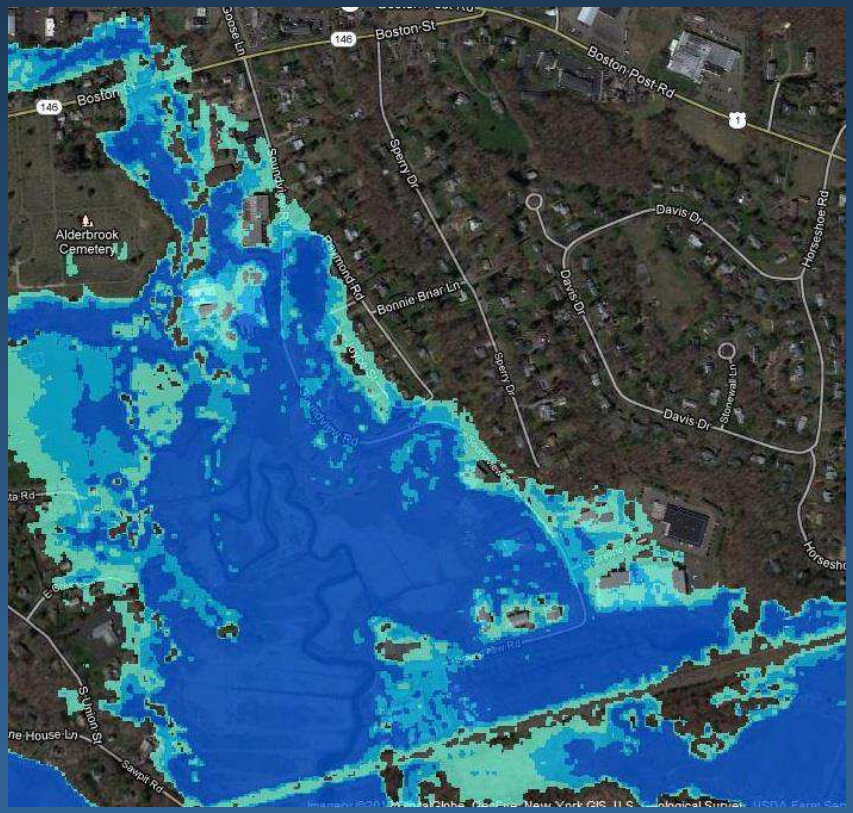
2080s Daily Inundation

Source: TNC (www.coastalresilience.org)

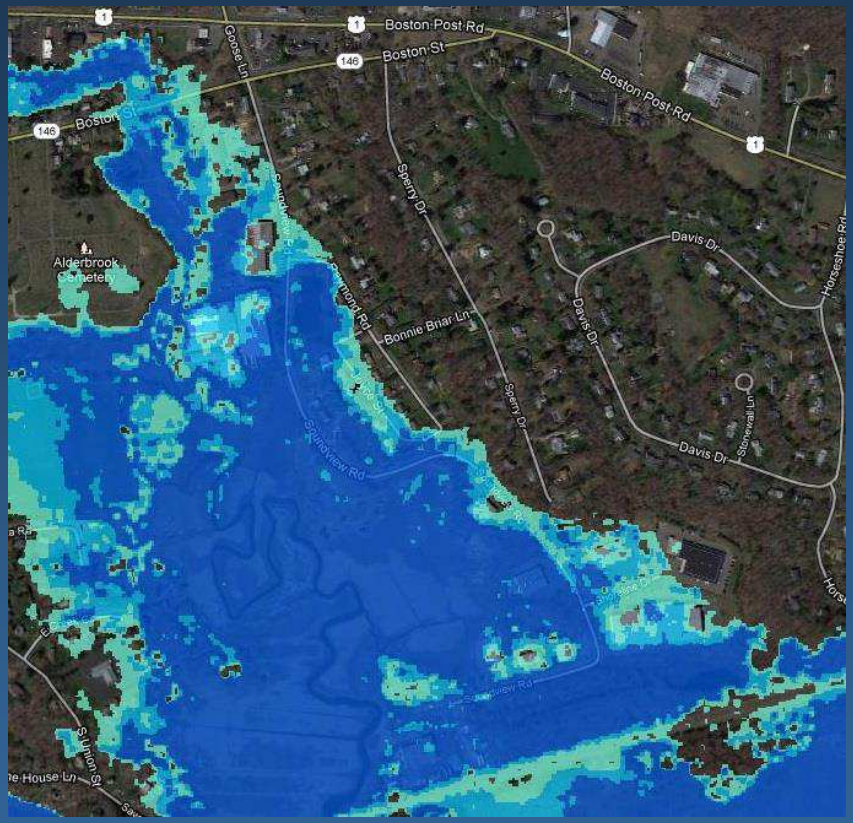
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Neighborhood Plan Example – Soundview Road

- Scenarios that informed the Soundview Road plan



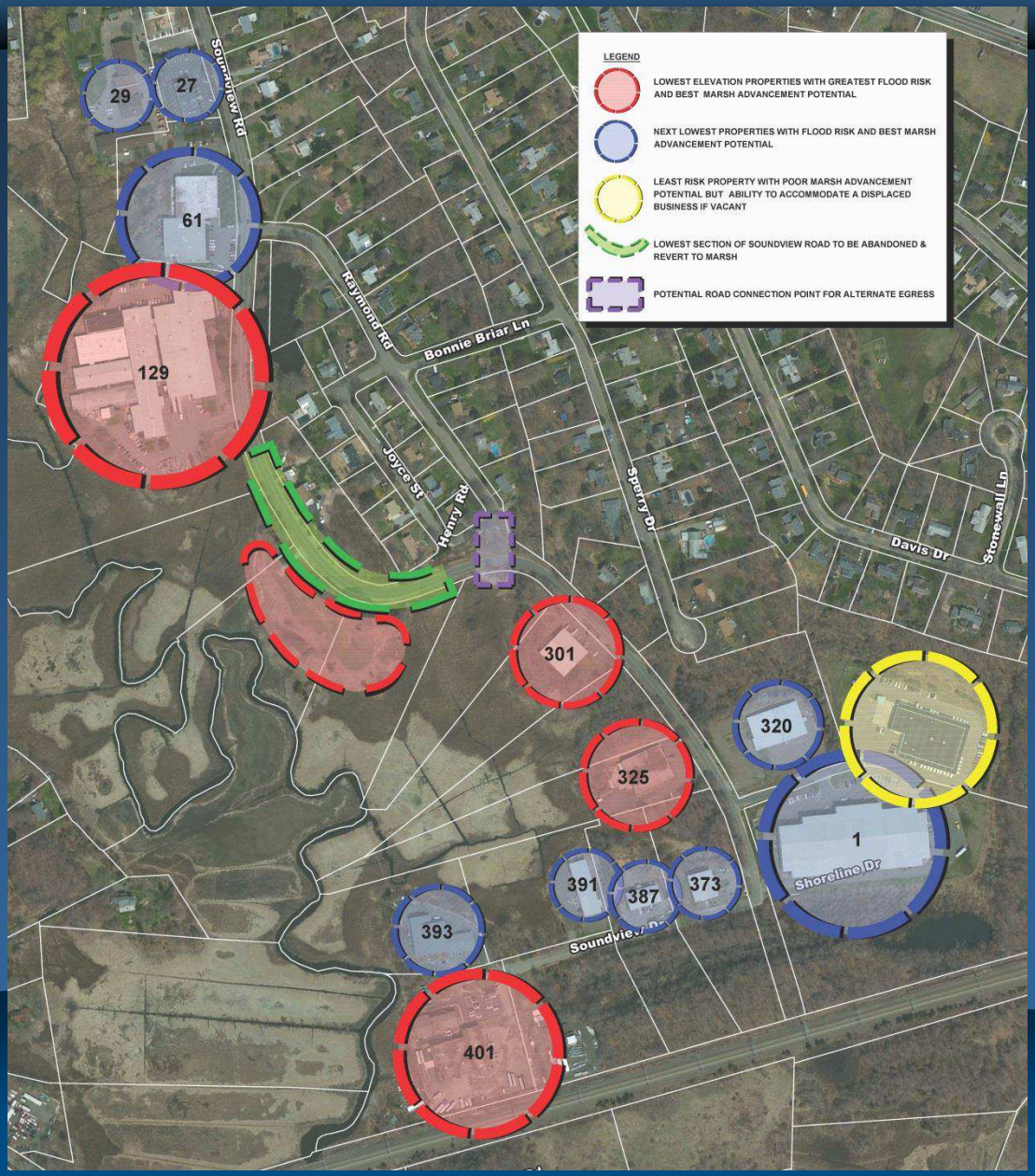
Present Day Cat 2 Storm



2050s Category 2 Storm

Source: TNC (www.coastalresilience.org)

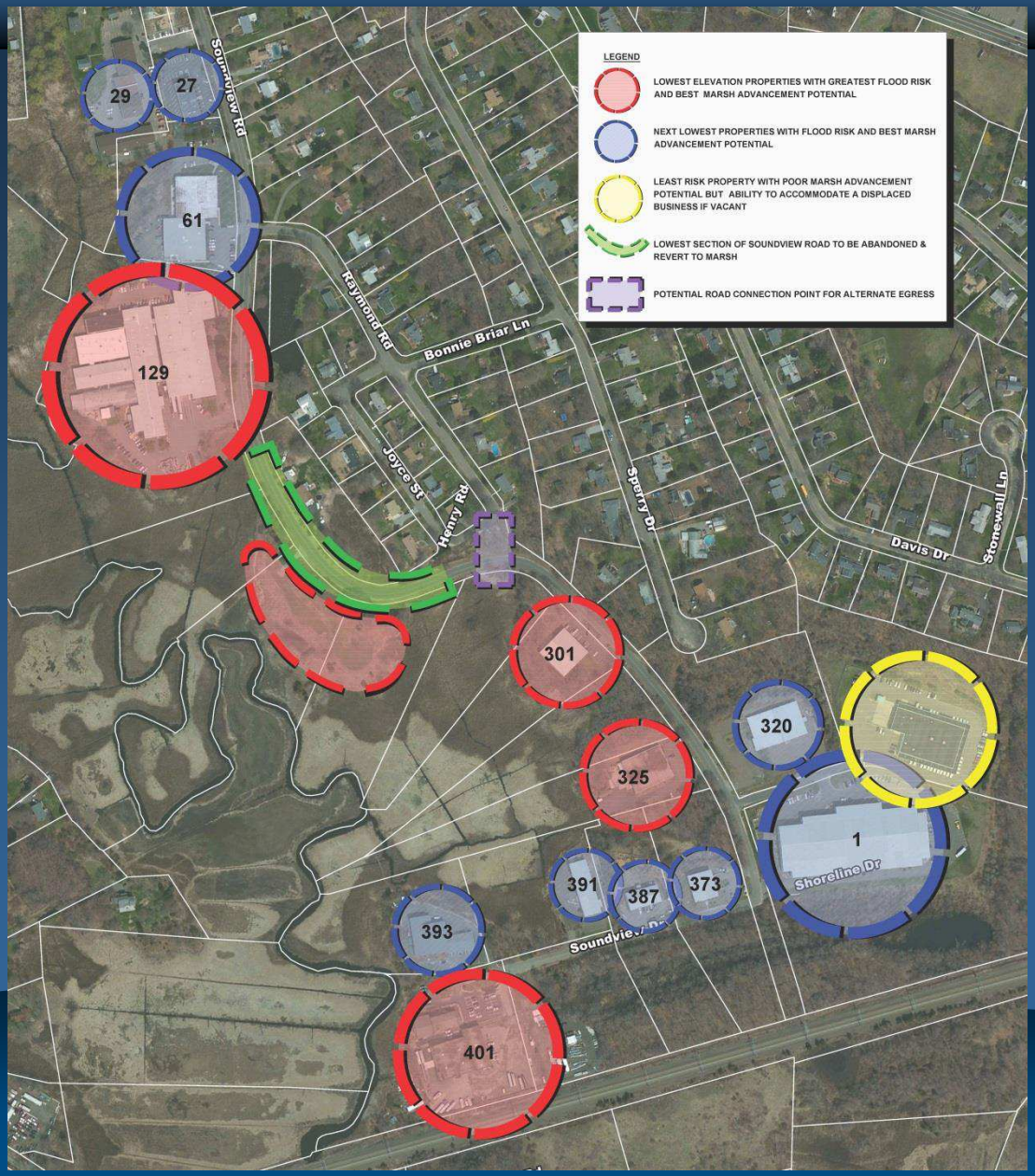
Neighborhood Plan Example – Soundview Road



- Coastal adaptation may require <u>tradeoffs</u>:
  - New road connection vs. raising Soundview Road's lowest section
  - Floodproofing nonresidential properties vs. relocating them locally vs. relocating them regionally

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Neighborhood Plan Example – Soundview Road



- Coastal adaptation may require <u>tradeoffs</u>:
  - Relocating one business vs. another business
  - Facilitating marsh advancement on private properties vs. on Soundview Road

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Neighborhood Plan Example – Soundview Road



Coastal adaptation may allow different outcomes:

- Relocated residents from elsewhere may be able to settle here
- Housing would need to be resilient and able to withstand floods and storm surges
- Space for tidal marshes must be available

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Neighborhood Plan Example – Seaside Avenue

- Scenarios that informed the Seaside Avenue plan



Sandy 2012
Source: USGS

Neighborhood Plan Example – Seaside Avenue

- Scenarios that informed the Seaside Avenue plan



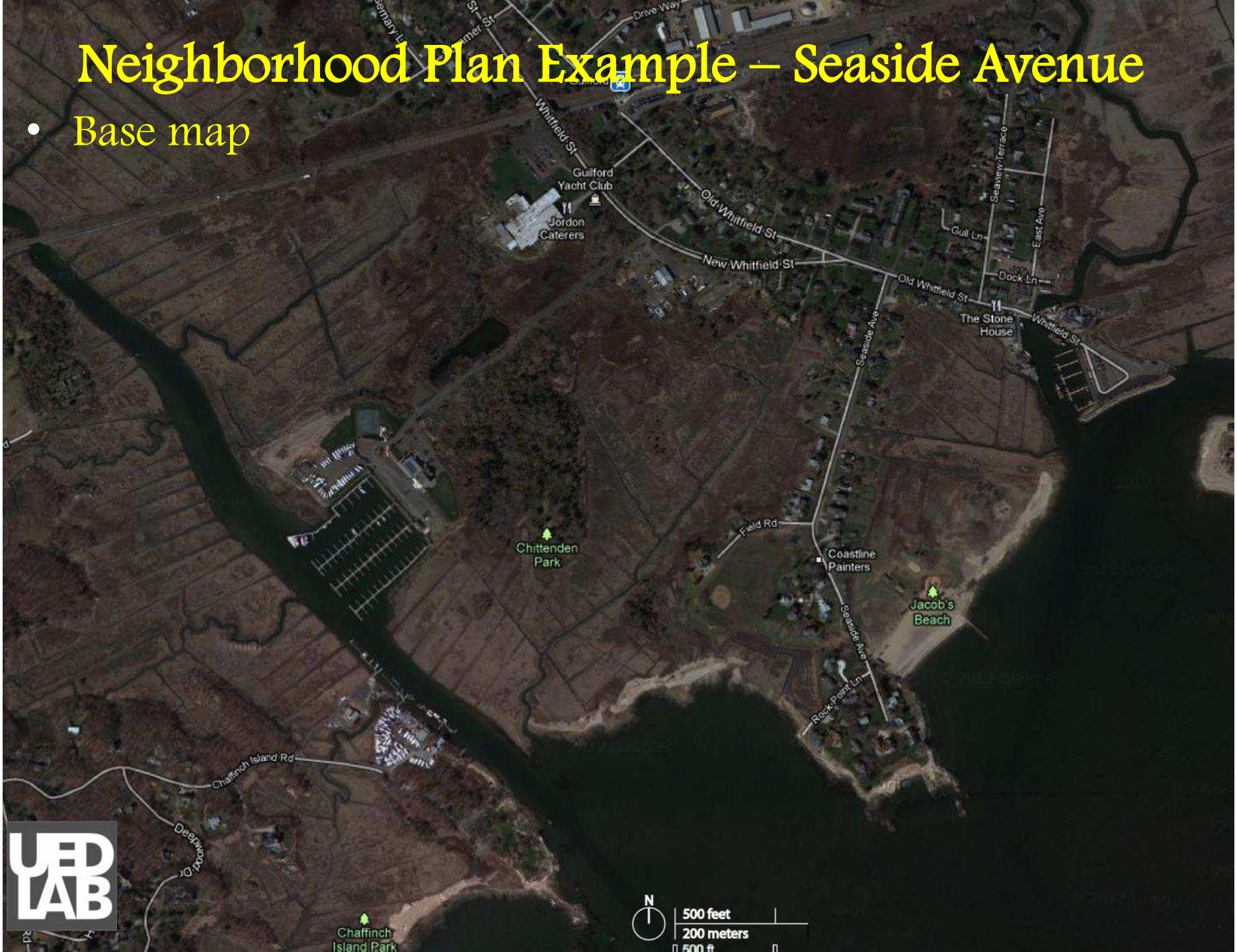
Neighborhood Plan Example – Seaside Avenue

- Scenarios that informed the Seaside Avenue plan



Neighborhood Plan Example – Seaside Avenue

- Base map



Neighborhood Plan Example Seaside Avenue



Neighborhood Plan Example Seaside Avenue

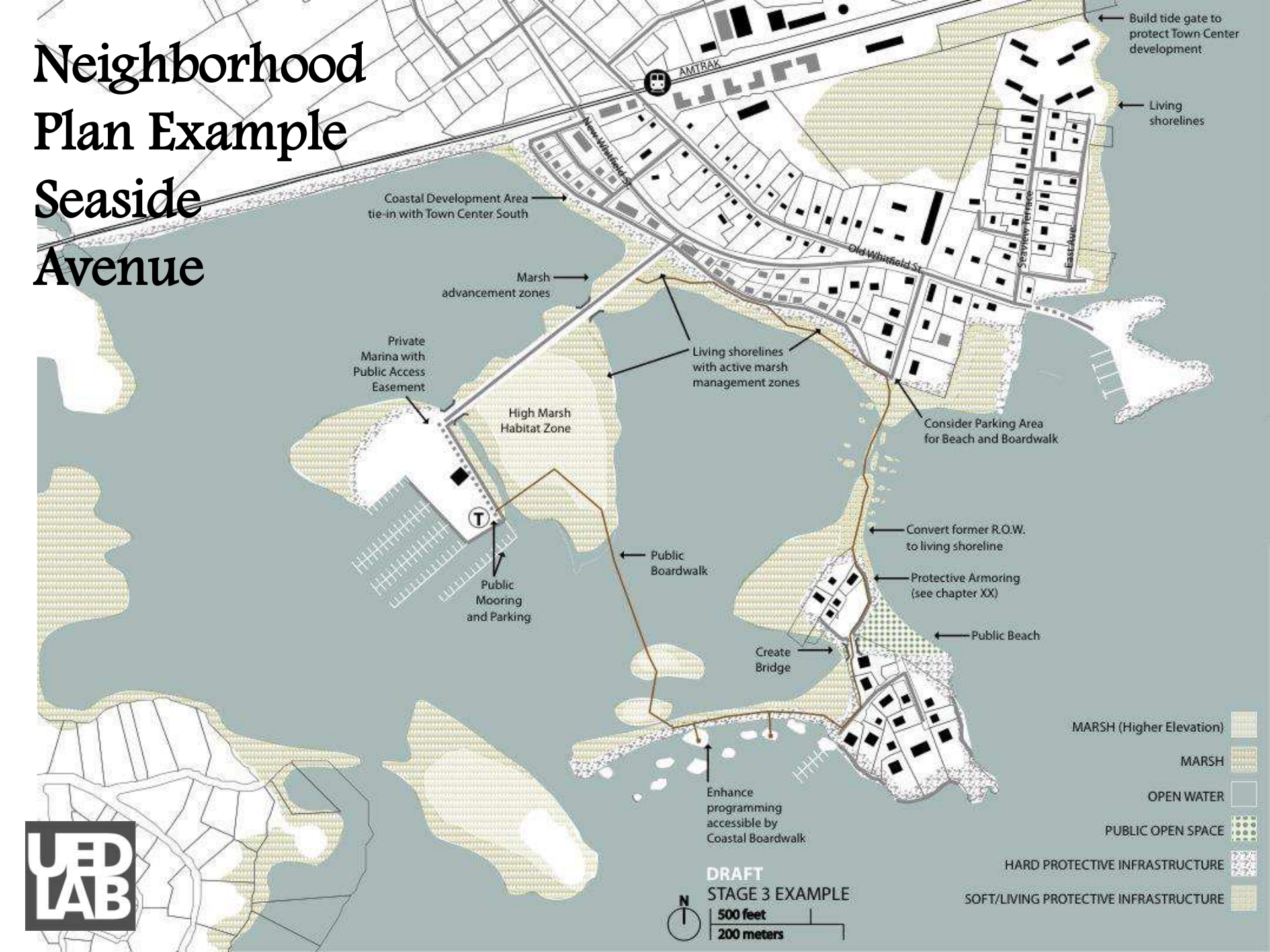




Neighborhood Plan Example Seaside Avenue

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Neighborhood Plan Example Seaside Avenue



Neighborhood Plan Example – Seaside Avenue

- Coastal adaptation may require phasing over time:
  - Actions in the short term will help residents live with floods
  - Residents would relocate as daily or storm surge floods worsen
  - Access and domestic wastewater disposal to be addressed
  - Realignment of the coastline would occur over the long term
- Would it be prudent to sustain small island communities?

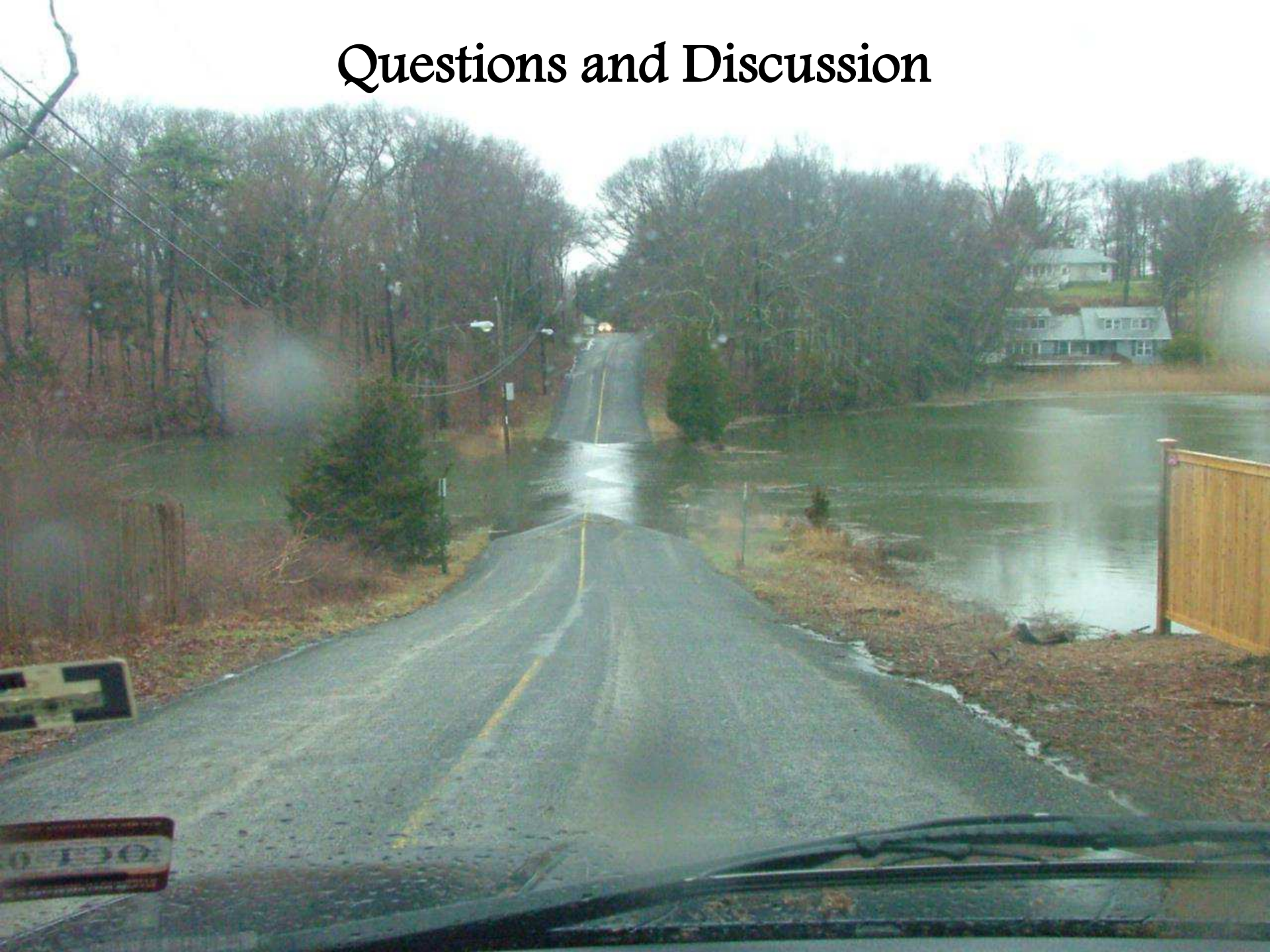
Next Steps

- Final Draft Community Coastal Resilience Plan due to NOAA at the end of July 2013
- Committee to meet again in August to discuss implementation and neighborhood planning

How to Stay Involved

- Thoughts??

Questions and Discussion



Appendix B
Matrix of Adaptation and Resilience Options

Matrix of Adaptation and Resilience Options

Shorefront Neighborhoods	*Old Quarry*	*Little Harbor*	*Shell Beach*	*Leetes Island*	*Trolley Road*	*Sachems Head*	*Vineyard Point*	*Indian Cove*	*Mulberry Point*	*Tuttles Point*	*Chaffinch Island*	*Chittenden Park*	*Jacobs/Seaside*	*Marina*	*Grass Island*	*Circle Beach*
Building codes (freeboard, V zone standards in A zones)			x		x	x	x	x	x	x			x	x		x
Acquisition of damaged properties			x		x	x	x	x	x	x			x			x
Zoning overlays			x		x			x	x	x			x			x
Zoning amendments			x		x			x	x	x			x			x
Coastal realignments through any of the above			x		x			x	x	x			x			x
Hard shoreline protection						x	x	x	x	x				x		
Living shorelines											x	x	x		x	
Buffers for flood protection	x	x	x	x	x	x	x	x	x	x						x
Land acquisition for tidal marsh migration	x			x					x	x	x	x	x			x
Land conservation for tidal marsh migration	x			x					x	x	x	x	x			x
Elevation of roadways	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x
Abandonment of roads			x	x	x	x	x	x			x	x	x			x
Re-evaluation of emergency routes				x		x	x	x		x						
Alternate egress		x		x		x	x	x		x						
On-site retrofits of septic systems	x	x	x	x	x	x	x	x	x	x	x		x	x		x
Community wastewater systems	x	x	x	x	x	x	x	x	x	x			x	x		x
Extension of sewer system	x	x	x	x	x	x	x	x	x	x			x	x		x
Individual water treatment systems	x	x	x	x				x	x	x	x					
Community water systems	x	x	x	x				x	x	x	x					
Extension of water mains	x	x	x	x				x	x	x	x					
Vacate properties	x	x	x		x		x	x	x	x	x		x			x

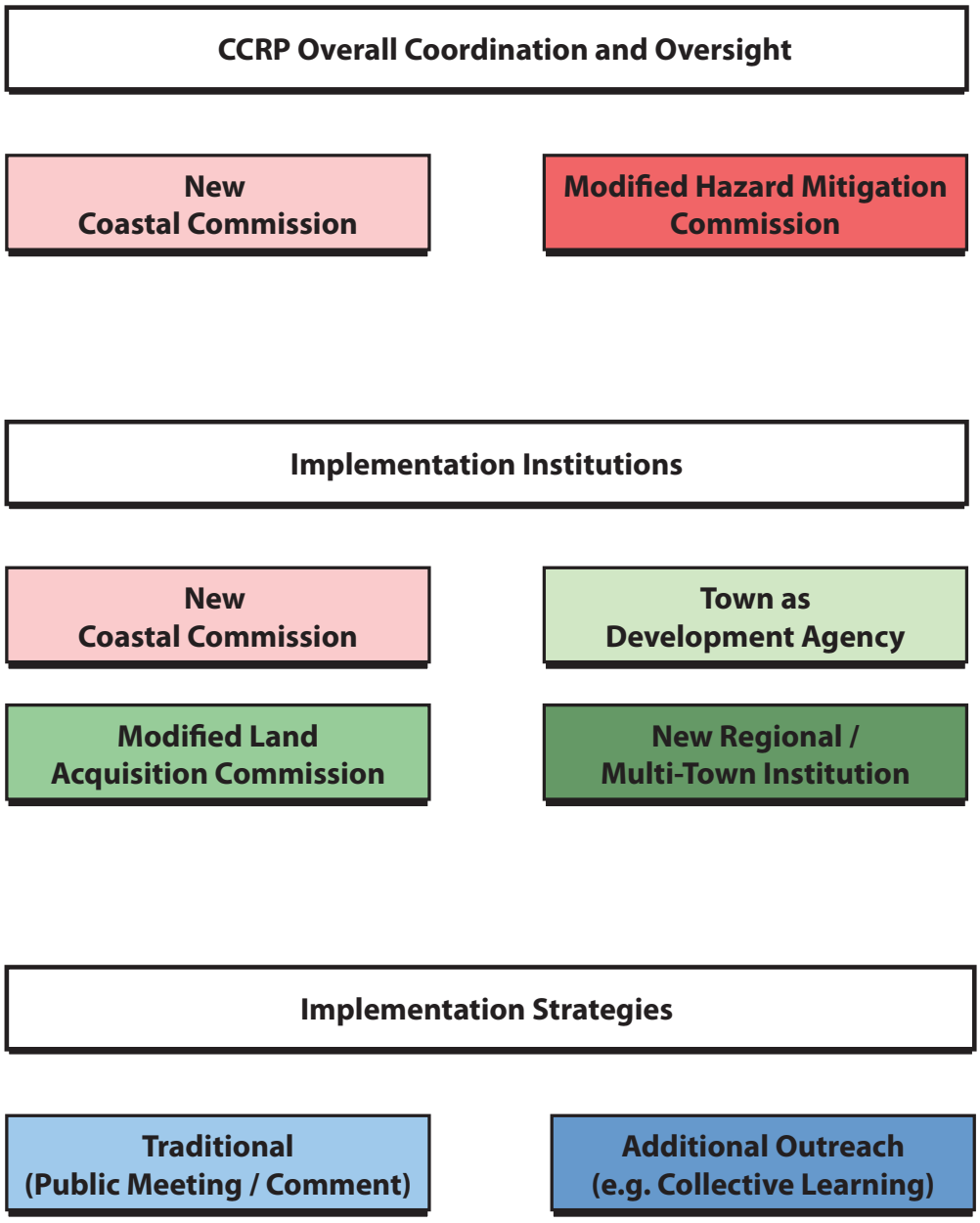
Matrix of Adaptation and Resilience Options

Inland Areas and Neighborhoods	146 at Leetes Marsh	146 at Great Harbor	146 at Long Cove	146 at West River	Upper West River Est.	Meadow/Fair/Norton/Rosemary	Whitfield Street	Public Works Garage	Town Center South	Seaview Terrace	Boston Terrace	Soundview Road	Horseshoe/Cornfield	BPR at East River	Upper East River	
Building codes (freeboard, V zone standards in A zones)					x	x	x	x	x	x	x	x	x	x		
Acquisition of damaged properties												x				
Zoning overlays					x	x	x		x			x	x			
Zoning amendments					x	x	x		x			x	x			
Coastal realignments through any of the above					x	x	x					x	x			
Hard shoreline protection																
Living shorelines																
Buffers for flood protection					x	x	x	x	x			x	x	x	x	
Land acquisition for tidal marsh migration					x	x	x	x	x			x	x	x	x	
Land conservation for tidal marsh migration					x	x	x	x	x			x	x	x	x	
Elevation of roadways	x	x	x	x	x							x		x		
Abandonment of roads								x				x				
Re-evaluation of emergency routes	x	x	x	x								x		x		
Alternate egress					x	x	x			x	x	x	x	x		
On-site retrofits of septic systems					x	x	x	x	x	x	x	x	x	x		
Community wastewater systems					x	x	x	x	x	x	x	x	x	x		
Extension of sewer system					x	x	x	x	x	x	x	x	x	x		
Individual water treatment systems																
Community water systems																
Extension of water mains																
Vacate properties						x	x	x				x				

Appendix C
Graphics for Implementation Scenarios

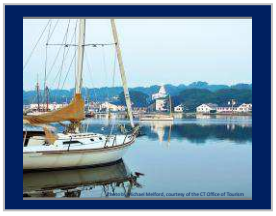
IMPLEMENTATION SCENARIOS

There are three general areas with multiple options within to be decided for implementation of the CCRP:



Implementation scenarios regarding **management of coastal real estate and structures**, **shoreline protection and management of coastal and near-shore lands**, **roads and roadway alterations**, and **protection or replacement of water supply wells and septic systems** vary depending on which option is chosen within each of the three areas, and which sources of funding (e.g. FEMA mitigation funds) are sought. There are multiple possible combinations per each of these issues.

Appendix D
Introductory Material
Connecticut Community Recovery Resource Guide and Hurricane Sandy Supplement



Connecticut Community Recovery Resource Guide

Please read this before attempting to use the Community Recovery Resource Guide and the Hurricane Sandy Supplement.

Using the Community Recovery Resource Guide

The *Connecticut Community Recovery Resource Guide* and *Hurricane Sandy Supplement* provides information on more than one thousand sources of funding or technical assistance that can be used by communities across the State, especially those facing the rebuilding of neighborhoods, business districts, and community facilities following a severe weather event or other disaster.

The *Community Recovery Resource Guide* is an introduction of basic information about the myriad number of programs available to communities and organizations; it is a starting point for researchers, grant writers, and decision makers. Most of the programs presented in the *Guide* are ongoing, without regard to the period following a Disaster Declaration. The *Hurricane Sandy Supplement* to the *Guide* speaks directly to the programs offered in response to Hurricane Sandy.

The user of the *Guide* should always consult directly with the provider of a potential resource for program changes, updates, and eligibility. Resources in the *Guide* are identified for general informational purposes only, and compiled with publicly available information or with information provided by sources that is publicly obtainable.

The Guide is presented in fourteen sections, they are:

Section I: Disaster-Specific Recovery Programs
Section II: Disaster-Applicable Recovery Programs
Section III: Non-Governmental and Corporate Giving Programs (National Scope)
Section IV: Non-Governmental and Corporate Giving Programs (Region/State-Specific)
Section V: Community Foundations of Connecticut
Section VI: Connecticut State Agency Funding
Section VII: Links to Connecticut State Government Agencies
Section VIII: Economic Development Programs
Section IX: Connecticut Main Street Programs
Section X: Housing Development Programs
Section XI: Connecticut Habitat for Humanity Affiliates
Section XII: National and Connecticut Regional Land Trusts
Section XIII: Regional Planning Agencies
Section XIV: Publications

In addition the *Hurricane Sandy Supplement* to the *Guide* provides the language of House Bill 152 and the programs offered that directly or indirectly are offered as a result of the funding made available.

FEMA

Appendix E
Approaching the Community Coastal Resilience Plan as a Collective Learning Process

Appendix E: Approaching the Community Coastal Resilience Plan as a Collective Learning Process

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Overview: The Challenge of Coastal Resilience Implementation

This appendix explains an approach to taking action on coastal resilience within a community given the complex nature of this problem. It is adapted from hundreds of applications worldwide in practice in addition to years of scholarly research. This "primer" briefly explains why such an alternative approach is needed, how it is different from typical approaches, its requirements, who is involved, and how participants work together on a shared concern throughout a process. It is complementary to the content of the COMMUNITY COASTAL RESILIENCE PLAN, and a means of overcoming barriers to plan implementation and more. It concludes with an example application within a coastal neighborhood, and considers implications to future planning efforts and instruments. The following 5 ideas are presented and organize the document. 1 through 4 are explained within *part 1.0 – Background and Context*, and 5 within *part 2.0 – Example Application*.

1. **Coastal resilience is an adaptive, "wicked" problem that requires an atypical approach.**

2. **One approach to facilitate resilience given these conditions is through a collective learning process, which seeks to enable citizens and communities to address unprecedented adaptive challenges out of their own volition.**

3. **A collective learning process requires acknowledging and integrating multiple types of knowledge, interests, and values among all participants, and does so by enabling transformative learning and development.**

4. **Specific prerequisites, adherence to key principles, and commitment by all participants largely influence the effectiveness of a collective learning process.**

5. **A collective learning process can be applied in a coastal neighborhood, with implications for future planning.**

1.0 BACKGROUND AND CONTEXT

1.1 Coastal resilience is an adaptive, "wicked" problem that requires an atypical approach.

As elaborated in this COMMUNITY COASTAL RESILIENCE PLAN and previous reports titled The RISK AND VULNERABILITY ASSESSMENT REPORT, and REPORT OF OPTIONS TO INCREASE COASTAL RESILIENCE, coastal resilience is about adapting to ongoing changes in our coastal environments. Extreme storms, sea level rise, and other threats will create new conditions that must be continually addressed over the next multiple decades as the circumstances of climate change unfold.

There are two general types of "change challenges" that arise given these evolving threats. Simultaneously acknowledging and addressing both will be essential to enable coastal resilience. However, the two types are usually not clearly distinguished and therefore not equally acted upon. The first type can be called "technical challenges."[1] While neither easy nor insignificant, these involve circumstances in which the skill set necessary to navigate them is well known or established. For example, learning to land an airplane with damaged landing gear is largely a technical challenge, as the routines by which a pilot is trained to effectively deal with such circumstances are well practiced and proven. Similarly, the skills by which an engineer can conceive and deliver designs for protective infrastructure to guard against rising waters are also well established. Both are helpful in maintaining the well-being of the "patient", be they plane passenger or citizen residing along the coast. Yet the latter example is only partially adequate for enabling coastal resilience.

Conversely, coastal resilience is a different type of challenge, known as an "adaptive challenge" or "wicked problem."[2] While also containing multiple technical challenges, (many of which are addressed in this plan), they require something more than incorporating new technical skills into our current mindset. They require transforming our mindset and subsequent behavior in addition to adding or executing new skills. "Living with the water", mentioned in Chapter 5, is one example of people in other places in the world dealing with adaptive challenges along the coast. Moreover, the adaptive challenge of coastal adaptation involves changes regarding governance, finance, access to civic services, and personal responsibility that largely stem from shifts in peoples' perspectives, as prior views and agreements that work in relatively stable conditions become no longer valid. Further complicating matters, these "wicked problems" have multiple conflicting interpretations, are multi-causal, unique, have no correct, stable, testable answer, and they cannot be resolved without changes among citizens and the overarching society that influence them. Therefore, addressing complex, adaptive challenges like coastal resilience demands an implementation strategy that is as much about *learning* among multiple affected people as it is about changes in physical and regulatory environments.

Recognizing this demand and acting on it is uncommon. Scholars of change management note, "The biggest mistake leaders make is when they apply technical means to solve adaptive challenges."[3] However, important to the design and execution of planning and implementation efforts that heed this difference, "distinguishing adaptive challenges from technical ones brings our attention back from the 'problem' to the 'person(s) having the problem'."[4] A major advantage of working on these issues through this COMMUNITY COASTAL RESILIENCE PLAN is that local municipalities such as Guilford are ideally scaled to deal with adaptive challenges because they can be worked out among citizens. Means to incorporate these concepts into the design and practical execution of planning and implementation efforts are explained in this appendix.

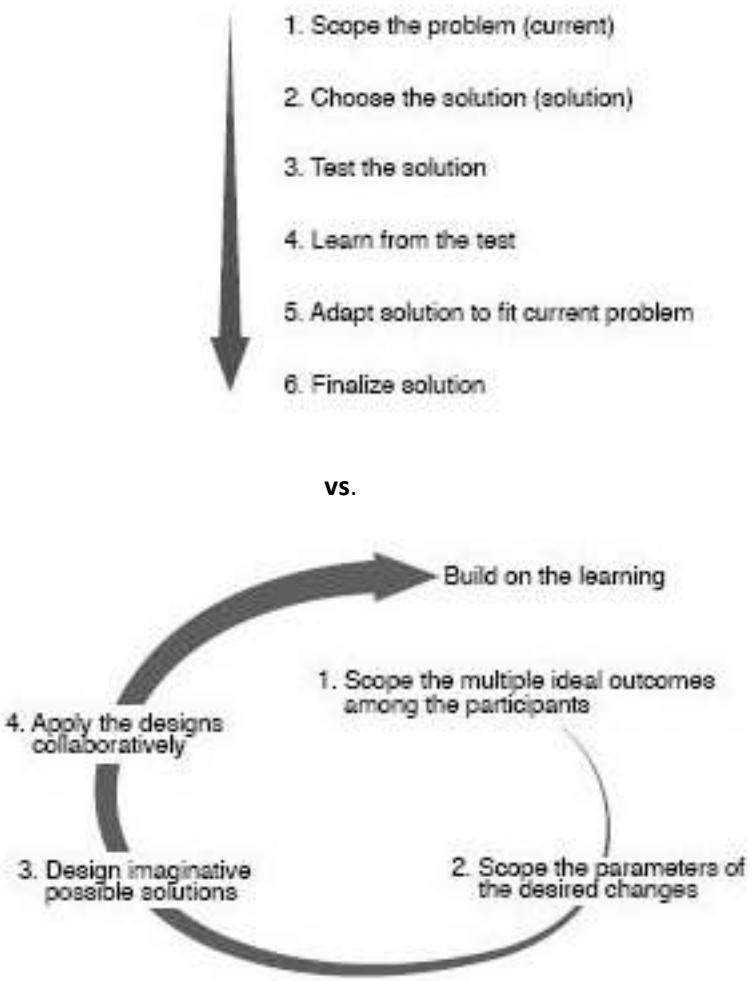


Figure 1: Differences between addressing technical challenges (top image) vs. adaptive challenges (bottom image)[5]

1.2 One approach to facilitate resilience given these conditions is through a collective learning process, which seeks to enable citizens and communities to address unprecedented adaptive challenges out of their own volition.

Approaching the adaptive challenge of coastal resilience as an opportunity for learning among affected citizens requires a number of changes to typical planning and decision-making processes. Collective learning involves multiple types of knowledge, interests, and values in exchange among individuals and groups. Because complex problems such as climate change *occur* differently to different people and groups[6], it is not typically effective to have any one of them "educated" by any assemblage of the others. An alternative is to enable iI ndividuals and groups to collaboratively, interdependently develop means for adapting to the challenge out of their own volition. This is a central goal of a collective learning process.

To do so, members of all affected groups need to be represented, in communication, and open to learn something from any group they aren't a part. While certainly not a simple task, methods are available to guide this process. Participants may include scientific and engineering advisors, town administrators, individual citizens (both supportive *and* resistant to change), at-risk communities, planners and designers, and facilitators (see Figure 2). Identifying people representing these groups in a specific place (such as a "zone of shared risk" as described in Chapter 7) is one of the first steps of establishing a collective learning process (see part 2).



Figure 2: A collective learning process involves multiple types of participants[7]

1.3 A collective learning process requires acknowledging and integrating multiple types of knowledge, interests, and values among all participants, and does so by enabling transformative learning and development.

Participants in a collective learning process represent different knowledge cultures. In the case of coastal resilience, climate, ecosystem scientists, designers and engineers often represent a "specialized knowledge" culture, town administrators and elected officials an "organizational knowledge" culture, and citizens both "individual" and "local knowledge" cultures. Each has their own preferred sources of information and its validation, all with their own respective blind spots. Specialized and organizational knowledge are typically disproportionally valued relative to individual, local, and holistic knowledge, with specialized most valued (See Figure 3).

Yet the knowledge and commitments required to address adaptive challenges like coastal resilience span all of these cultures. In addition to empirical facts, (a typical focus of weighted specialized knowledge), these challenges also involve the perspectives of individuals and groups who *filter* this information and therefore likely interpret and value it differently. Perspectives vary widely, interact, and often conflict with those of others through social interactions and decision processes. These facets may be overlooked in problem solving activities like coastal

resilience planning, impeding efforts that are ultimately effective. For example, common approaches begin by valuing comparatively readily observable content and measurements and disproportionately use them to define the problem of interest. Problem defining may look like the following: data show trends that lead to projections of anticipated sea-level rise and extreme storms with severe impacts to coastal settlements. Therefore, ideas to adapt to these changes are developed, which often reflect the technical aspects of the challenge and the particular interests of the observer(s) structuring the problem (e.g. infrastructure, regulation, engineering, finance, ecosystem management, governance, etc.) Actions are proposed, with varying support and success. Many current public processes intended to address coastal resilience function this way. Yet risks may persist, perhaps even grow. *Problem formulation* in this example is only partially complete.

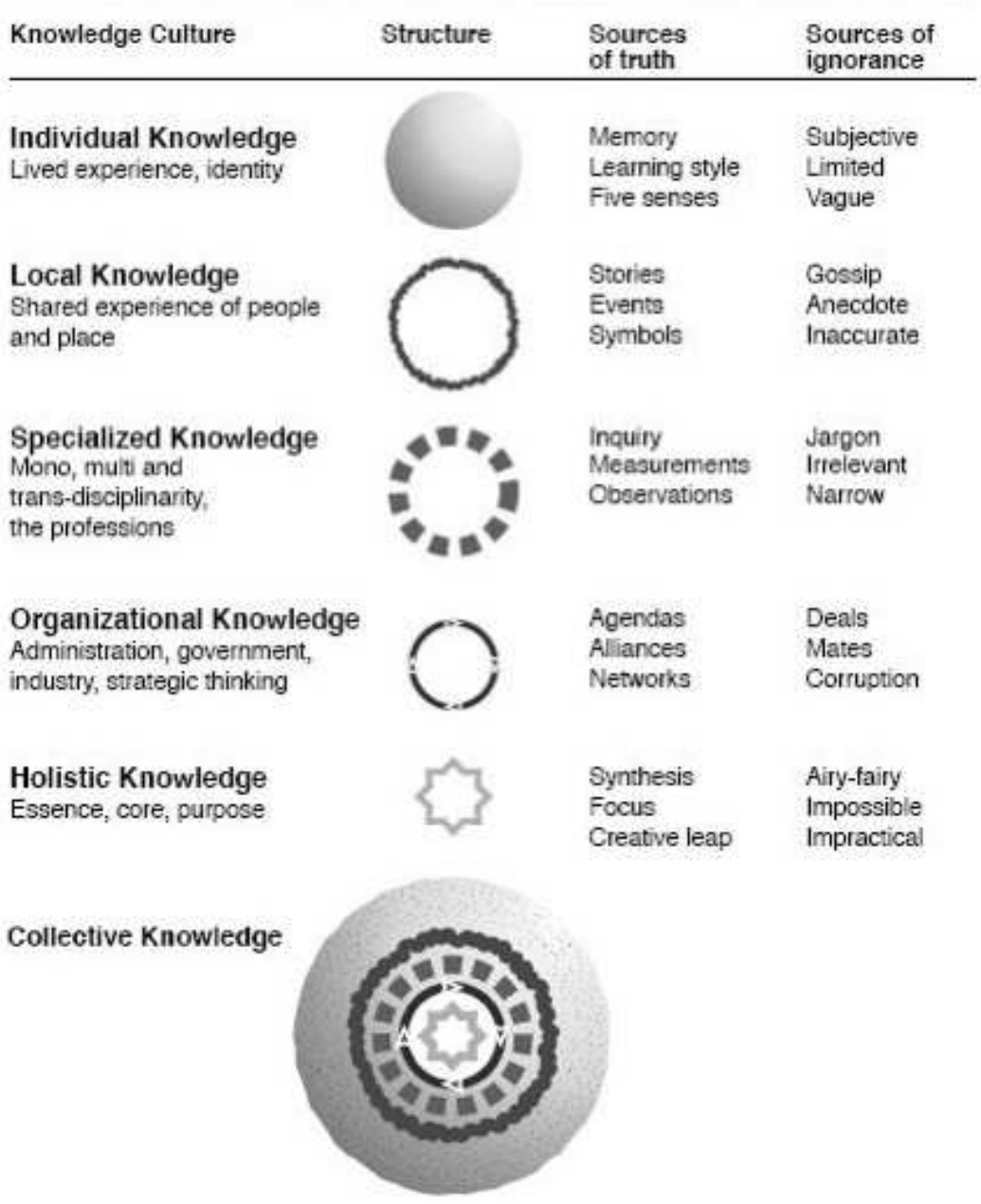


Figure 3: Knowledge cultures needed for addressing adaptive challenges such as coastal resilience[8]

Therefore, a central task in a collective learning process is to develop a more comprehensive formulation of the problem, including how it *occurs* to affected participants that span multiple knowledge cultures. Another task is the acknowledgement, integration, and ideally, change in perspective among representatives of these multiple knowledge cultures toward a *shared* purpose. The process itself includes collectively creating such a shared purpose, as it is often obscured by special interests or structures that prohibit such unifying activities and ideas. These barriers may be real, imagined, or both. Perhaps counter-intuitively, *it is not enough to assume* that "coastal resilience" is such a galvanizing, shared purpose among all people along the coast, at least as it is currently communicated, understood, and interpreted by multiple knowledge communities. This partially explains resistance to the concept and its enaction. There are other chosen meanings and "competing commitments" among individuals and groups that override the capacity to enable coastal resilience that may not be realized and/or communicated. Accessing and clarifying these factors is yet another function of a collective learning process.

Key variables that enable (or inhibit) adaptive challenges like coastal resilience to be addressed by people are transformative learning and adult development among individuals.[9,10] Without going into detail, transformative learning is an often-overlooked type of learning that is a change in *how* we know as opposed to *what* we know. It is complementary to traditional informative learning, which seeks to add knowledge and skills to our existing way of thinking. An example of *informative* learning is the accommodation of new scientific knowledge of the impacts of climate change to coastal communities into our existing means of interpreting that information. An example of *transformative* learning is insight into the boundaries and effects of those very means of interpreting and making meaning about the information. The ability to engage in the practice of transformative learning is related to one's adult *development*, or ways of coping with the complex conditions we encounter day-to-day and over time while constructing meaning from these experiences. Thus, the "form" that "transforms" is our very way of making meaning as we navigate complicated issues like changes to our coastlines. Far beyond an academic exercise, transformative learning and adult development have large implications in practical decision-making processes such as coastal resilience planning. As such, public engagement efforts aiming to enable coastal resilience may benefit from specific exercises that acknowledge and incorporate means of addressing these issues.

Expanding problem formulation, creating a shared purpose, accessing and evaluating meaning-making and "competing commitments", and seeking to enable transformed perspectives through learning are tasks that are understandably far outside the purview of traditional planning and implementation efforts of coastal resilience. Again, this *adaptive challenge* demands particular ways for it to be effectively addressed; otherwise, resorting to existing methods and outcomes that are arguably inadequate may occur. While easier said than done, there are methods available to design and facilitate such a collective learning process in practice. Part 2 briefly explains an example application of a 6-step process in a coastal neighborhood.

1.4 Specific prerequisites, adherence to key principles, and commitment by all participants largely influence the effectiveness of a collective learning process.

Collective learning is not a flawless salve, nor easy or effortless. It is also not a substitute for traditional, one-way "informative" learning that aspires to lead to action; it is complementary. It is most appropriate and useful for:

- Individuals willing to work on the "whole" of an issue, and their own perspective on it
- Diverse interests coming together to work on a shared concern
- Projects that seek to encourage and enable transformative change, individually and collectively (as opposed to those wishing to maintain without change)
- Building an effective transdisciplinary team
- Resolving an adaptive challenge or "wicked" problem that requires changes in the society that causes it, as in coastal resilience

The collective learning process is *not* as useful for:

- Established, groups, individuals and interests who wish to continue unchanged
- Policy development where there is no room for change
- Problems where special interest groups are so entrenched and divided they aren't willing to come together for a common purpose
- Cases where other learning processes have been tried and failed leading to deep resistance
- The problem is simple and has an obvious, straightforward solution

A collective learning process has 3 required ground rules:

1. **Openness**
    a. Upon participating, every person accepts that these are the right people, this is the right time, this is the right place, everyone is committed to the task, whatever happens, happens, and if anyone isn't learning, they should move on. In other words, it isn't a space for "should have/would have/could haves."
2. **Dialogue**
    a. Every participant accepts to speak from the head *and* heart, to listen without judgment and "suspend disbelief", and to learn from each other.
3. **Diversity**
    a. Collective learning seeks to maximize instead of reduce diversity. This means establishing: mutual trust, mutual respect, inclusive language, use of the imagination, and an open mind.

Collective learning is based on an understanding that we learn from difference, not more of the same. It is the inverse of traditional change management that seeks to reduce difference and conflict (often relegating responsibility to centralized or external "control" of the change process). Collective learning recognizes that such wide differences in perspectives among participants may result either in conflict, resignation, stagnation, and failure ***or*** a source from which everyone gains while resolving complex issues. The latter outcome requires, at least, adherence to the above principles, and is a continuous *choice* to be made by participants working through an adaptive challenge.

2.0 EXAMPLE APPLICATION[11]

A collective learning process can be applied in a coastal neighborhood, with implications for future planning.

This section describes an example of approaching the COMMUNITY COASTAL RESILIENCE PLAN as a collective learning process. Figure 4 provides an overview of a 6-step process, all of which occurs before, during, and after a public workshop within a specific coastal neighborhood or "zone of shared risk." There are 4 overall learning stages, and each step and stage is described here in further detail. These steps may be repeated over time as conditions and actions change.

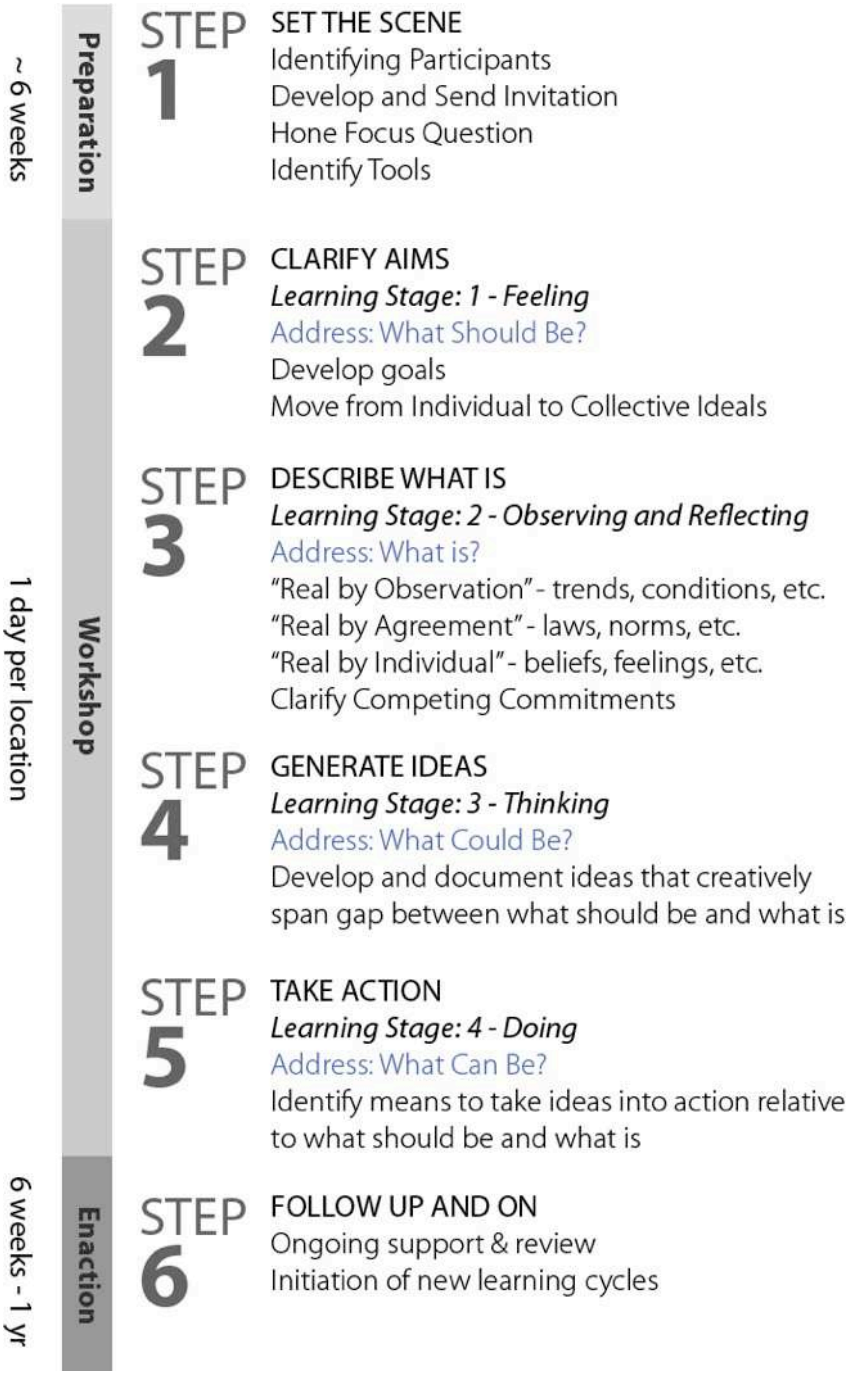
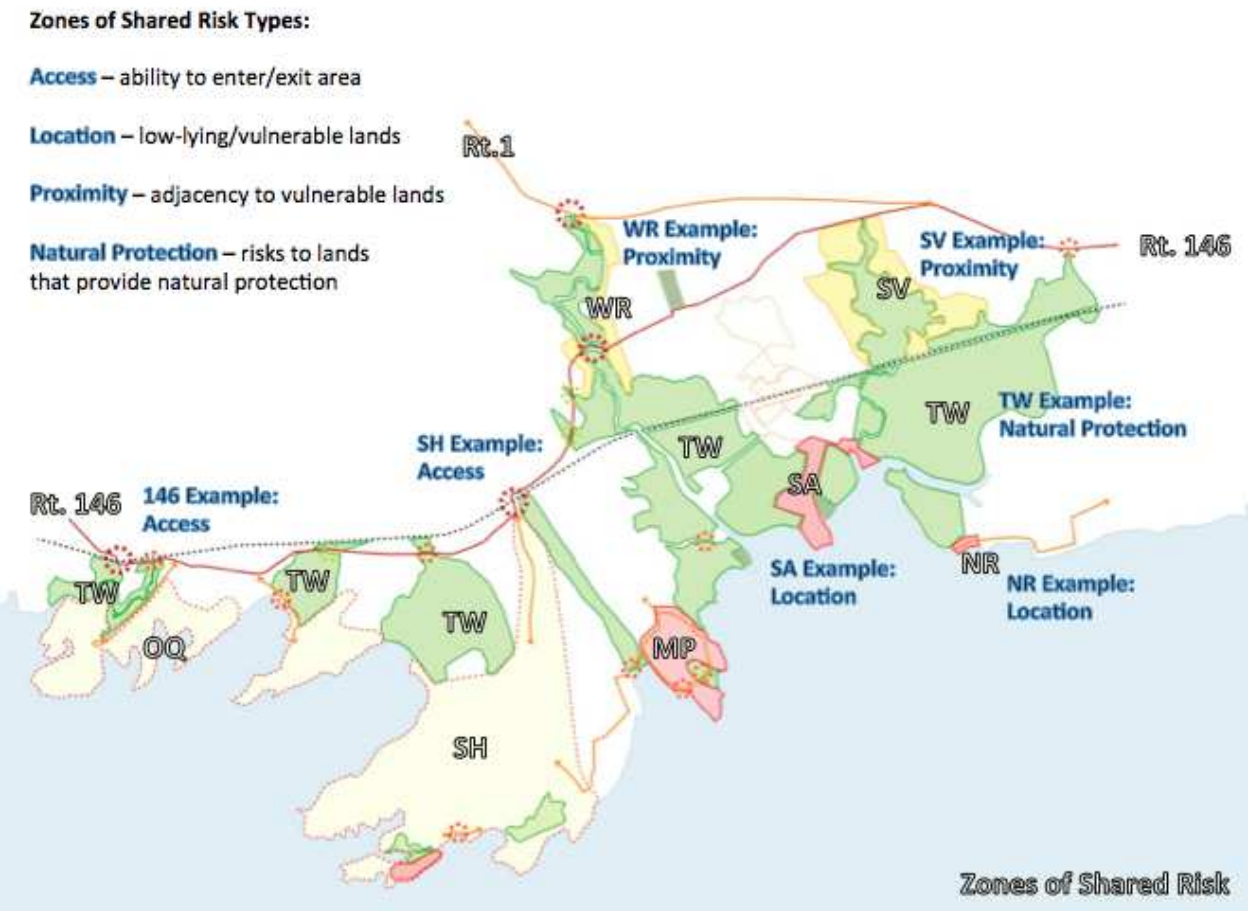


Figure 4: A collective learning process in 6 steps

Step 1. Invitations, Focus Question, and Tools

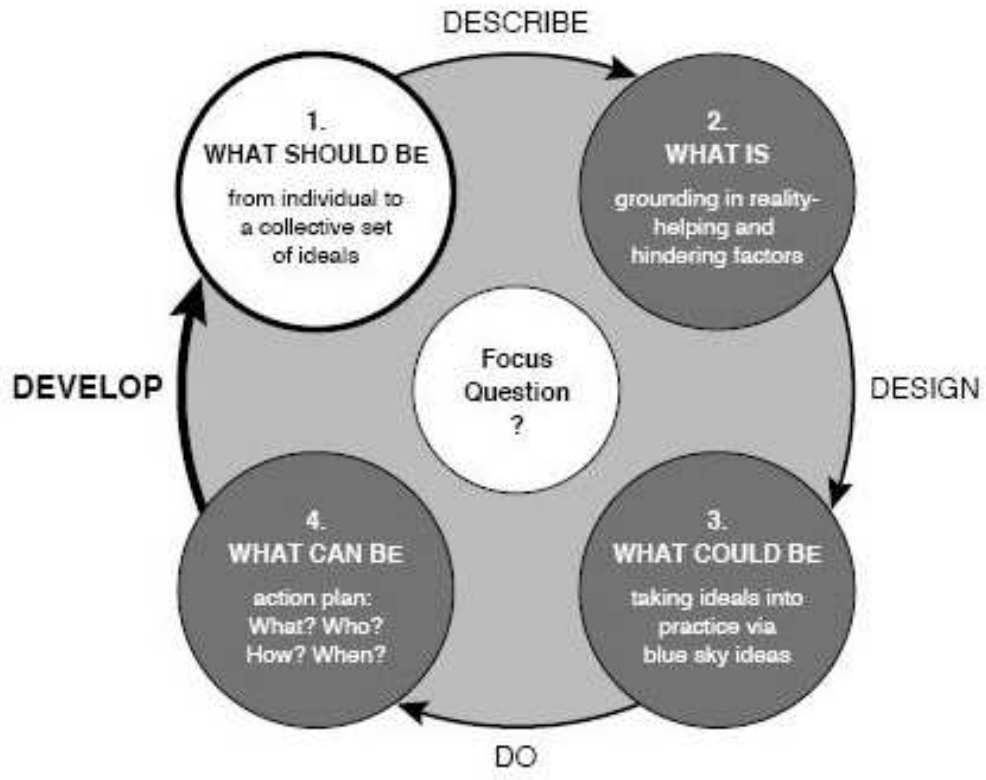
The first step involves identifying a shared issue, such as increasing physical risks and vulnerabilities to extreme coastal storms within a specific geography such as a "zone of shared risk" (see figure below). Diverse participants (see page E-5) associated with this area are to be identified and invited to participate in a one-day workshop (see steps 2 through 5) that will serve as a shared learning environment. Before invitations to the entire range of participants within an area are disseminated, a pilot group representative of all interest groups may help tailor the invitations to ensure compatibility. A project team should also be assembled covering four key roles: a chair, a "knowledge-broker", a facilitator, and an administrator. An individual may share some roles, yet they typically function more smoothly when separated. Most importantly*, the project team should not define the issue from the onset but only agree on a shared question.* This is because the diverse participants will bring their own knowledge, interests, and values that influence their own version of the issue. Tools and techniques appropriate to engage with anticipated participants are also developed at this time. Step one typically takes up to 6 weeks.

An example focus question to begin the collective learning process appropriate for coastal resilience might be: ***How can we help our neighborhood survive and thrive under these changing conditions?*** Working through participants' unique perspectives in response to such a focus question begins the one-day-per-location workshop described in step 2.



Step 2: **What Should Be?** *(Learning Stage 1)*

Once such participants are invited, tools identified, a focus question is established and a workshop is convened, participants are asked *what should be?* in relation to the focus question. This visioning activity reveals the participant's values. This process is greatly aided by a skilled facilitator sharing *their own* values, knowledge, and interests and how they relate to the focus question. Upon hearing other participants' (likely different) ideals, it becomes possible for the group to construct a common ideal that unifies and guides following activities. In other words, direction in a collective learning process comes from a shared vision developed by its participants in dialogue as a response to a question of *what should be*. In the case of coastal resilience, sharing ideals in this fashion is not typical, and may exceed both current and assumedly possible means of addressing problems on the coast while also raising potentially controversial ideas. These results are crucial to developing shared goals in addressing adaptive challenges. Again, it cannot be assumed that something abstract such as "coastal resilience" serves as a shared goal that will lead to effective action, yet it may serve useful as a starting point. This exercise tends to clarify among participants that ends are typically far more universal and agreed upon than means of getting there, and helps establish shared ownership over the trajectory of change in their location. Discussing "what should be" is more likely to yield innovative, foundational concepts when each participant's ideals are respected equally. Lastly, the desired outcome is a shared vision for the future, not a wish list of what isn't had now.



Step 3: What is? *(Learning Stage 2)*

The next step in a collective learning process is to transition in the workshop from discussing "what should be" to "what is" given the focus question. After summarizing the ideals developed in step 2, the project team asks all participants to describe what they consider are relevant existing "facts" that would aid in addressing the focus question. This is the "expanded" problem formulation step. Responses are separated into factors that that help or hinder the realization of the ideals developed in stage 2. It is likely that representatives of each knowledge culture will draw on different sources of evidence for their "facts". Individuals tend to draw on personal experience; communities on shared past events and future expectations; specialized knowledge on scientific or technical inquiry and measurement; organizations on ideas compatible with their own processes and agendas; holistic thinkers on creative interpretations of "the facts".

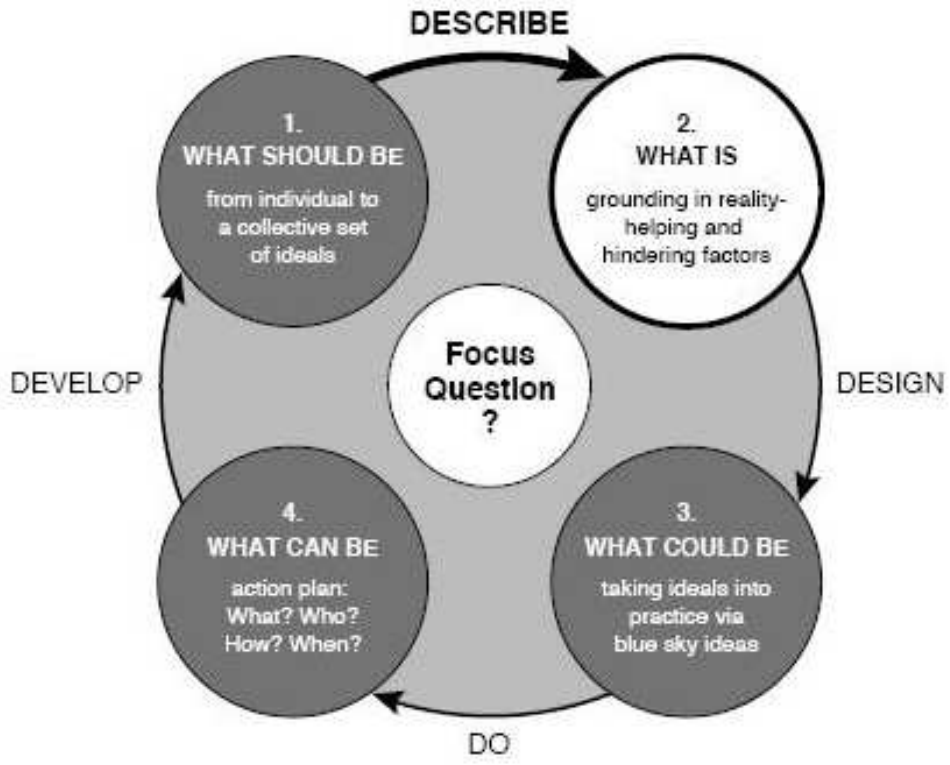
This stage is perhaps the most challenging or likely to breed conflict. Members of any knowledge community are likely not accustomed to publicly exploring how they interpret and value information, how some may be valued over other kinds, and the possible unintended consequences of doing so that may inhibit change amidst evolving circumstances. Facilitating respectful, constructive discussion is essential. Circling back to the shared ideals developed in step 2 is useful to work through these issues. Another way to navigate these conflicts is to utilize exercises designed to promote critical reflection and dialogue, both fundamental to enabling transformative and collective learning. These exercises permit clarification of multiple "realities" among participants as they describe, "what is". There are three general types that will arise in responses: *physically real* – that which is measurable in distance, time, or form; e.g. mean high water levels or marshland acreage; *real "by agreement"* – that which is real by collective declaration and adherence; e.g. laws, regulations, political/legal boundaries, what is acceptable as "normal"; and *real "by identity",* e.g. individually-derived beliefs, values, feelings, etc. Complicating matters, each type of "reality" likely differs among individuals and may *occur* to each participant as "real" (and therefore as valuable) as the next, hence creating conflict. The very practice of elucidating these concepts given the focus question in a respectful, open, constructive environment is useful in detailing the complex nature of "the problem" in a given context.

A third strategy is to clarify "competing commitments" among participants. These are often underlying factors that help explain why certain actions are taken or not taken given the focus question and the desired conditions declared in response to it generated in step 2. They are often well-intended commitments in their own right that rest on "big assumptions" that inhibit action toward such goals.

For example, coastal residents may declare that they wish to remain safely living in an at-risk location as long as possible; that "what should be" is a safe coastal environment for them and their family. However, "what is" may be that coastal risks are accumulating and they are unwilling to entertain new ways of permitting safe inhabitation under risky conditions, be they some combination of physical, institutional, regulatory, fiscal, and personal changes. Possible competing commitments here might be to "not threaten existing lifestyles", "avoid additional regulatory intrusions", "maintain existing beliefs", "protect assets and investments", "avoid listening to person X's perspective", "prevent any expenditures", and/or "maintain control." Each of these competing commitments rest on a big assumption, which might be stated as "these risks won't effect me personally in my lifetime", "someone/something else will take care of these issues", "there are ulterior motives for talking about this", "there is nothing that can be done about any of this", or "I/we have the right/best answer for dealing with this problem", etc.

While only an example, these are likely not far from typical concerns uncovered in a collective learning process at this stage. Working through these factors permits a much broader and representative picture of what *really* is within a coastal community as they consider actions to increase coastal resilience. Balancing the dominant characterization of coastal resilience as a technical challenge to be addressed by scientific knowledge and empirical facts with broader interpretations is a central challenge for both participants and facilitators in this step. As a benefit, sharing and documenting these ideas often opens up previously unrecognized opportunities for later steps in the collective learning process, as well as for means of addressing the adaptive challenge of coastal resilience itself. As these exercises convey, effective facilitation of a collective learning process includes creating a respectful, comfortable space to reflect and have dialogue about sensitive or unacknowledged yet influential ideas, actively partaking in these exercises (the project team is not "above" the learning process), practicing careful *listening,* and synthesizing what is in head and hearts of those in the room.

It is important that there is no prioritizing or ranking among different responses and approaches answering the question of "what is" given the focus question. Instead, all responses are considered as a group. Again, a goal is not prioritization but *a more comprehensive picture* of the "facts" as perceived and generated from the diverse perspectives of the participants in a given context. Clarifying these multiple conceptions of the facts highlights gaps in how the complex problem is understood and formulated, which in itself is a major contributing factor to its existence and ultimate resolution.

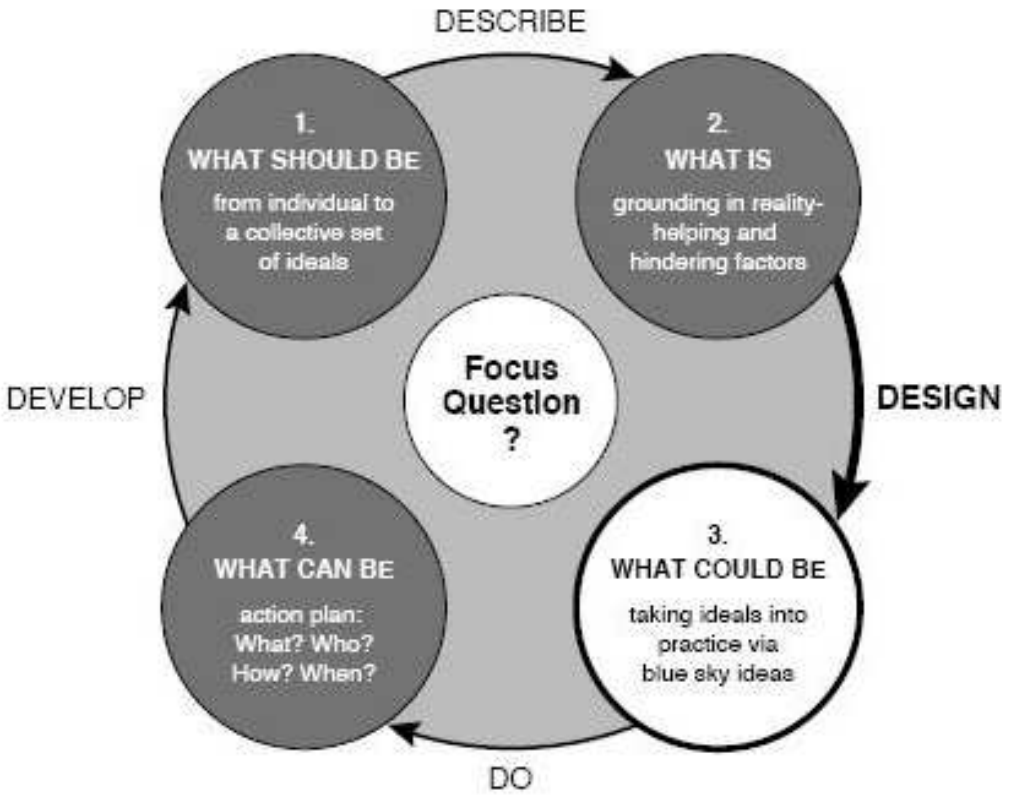


Step 4: What could be? *(Learning Stage 3)*

Step 4 involves transitioning in the workshop from scoping the facts to creatively generating new ideas. At the end of step 3, there should now be a clearer recognition among all participants of a gap between "what should be" and "what is" given the focus question. Step 4 uses this as a foundation to now creatively envision alternative strategies to address this gap.

This stage will greatly benefit from (although not be limited to) work already completed in this COMMUNITY COASTAL RESILIENCE PLAN document, as well as the REPORT OF OPTIONS TO INCREASE COASTAL RESILIENCE. For example, the mock-up plans for Soundview Road and Seaside Avenue in Chapter 7 explore possible changes over time utilizing multiple strategies, albeit generated without direct community involvement. This same planning and design process may also be collaboratively executed within the workshop for the coastal community in question with the aid of facilitators. Maps, drawings, sketches, text as well as other media may be employed to conceptualize means of addressing factors raised in steps 2 and 3, in addition to considering how they may change over time. It is important for these activities to not be bogged down by "being realistic" at this point; a goal here is to "think outside the box" and create innovative strategies ***that respond to and build on the ideas and factors developed in steps 2 and 3***. Example products of this exercise may range from visualized conceptual plans for physical and regulatory changes to a community as they change over time, to new means of addressing communication and collective problem formulation, to other forms of expression.

It is important to not let representatives of particular knowledge communities become overly dominant in this stage, as these exercises often come more naturally to holistic thinkers or creative professionals. Instead, their capabilities may aid in facilitating the entire groups' generation and support of collaboratively birthed ideas.



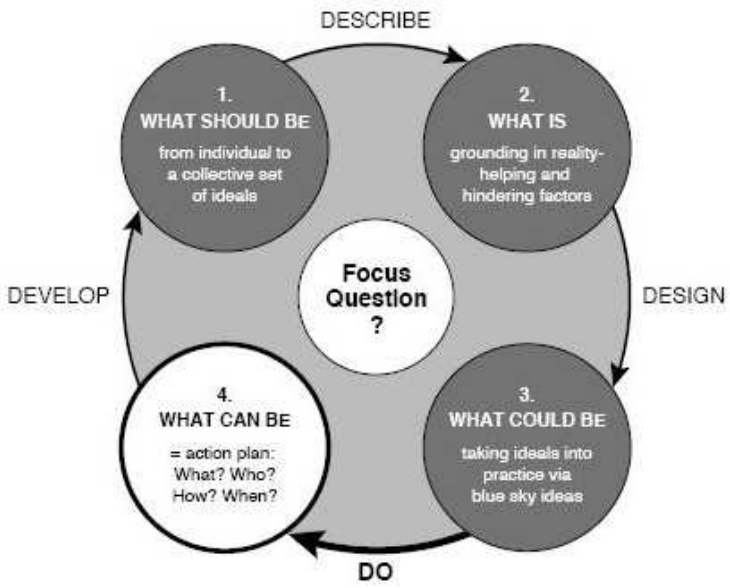
Step 5: What can be? *(Learning Stage 4)*

Step 5 concludes the one-day workshop with listing practical actions to be enacted or implemented. Transitioning from the "blue sky ideas" developed in step 4, this is the time to put those visions into practice. Rather than revisit the constraints developed in step 3, this step is instead about choosing who wants to be involved in which actions and how, on what timelines, with which indicators of what happens, through which communication, and with what means of staying accountable and having integrity about these agreements. These "action plans" are for each community they are developed by and seek to answer "what, why, who, how, where, and when." Examples of how this may be accomplished include addressing:

- Project titles (what is the project/program?)
- Aims (why is the project needed?)
- Names of the project team (who is to be involved?)
- Resources and in-kind support (how is the project to be resourced?)
- The setting (where is the action to take place?)
- Timetable (when is the action to take place?)
- Indicators (how do we evaluate the action?) and
- Communication (how do we share progress and maintain accountability?)

Participants of the collective learning process are to accept responsibility for arranging (not necessarily doing) for the action plan to proceed. Typically, invested individuals who've been part of the workshop act as a catalyst for each project, at least until future meetings or agreements. Projects or programs may relate to existing town administrative measures, in which means of working with formal institutions should also be determined.

Putting the content developed in the collective learning process into practice is essential for the learning to take root and affect change. Implementation of measures to address the adaptive challenge of coastal resilience may become visible to the broader community. Because of this, opponents may now come out of the woodwork, attempting to derail change efforts. In a way, the validity of change efforts is tested by the degree of rejection by those not involved in the collective learning process. More participants will need to be involved if the change(s) are to be embedded within the surrounding communities. Step 6 begins to clarify how this can be done.



Step 6: Follow up and on

Now post-workshop, Step 6 involves ways to ensure that the changes to implement the action plan are completed. It is likely that the energy and innovation present in the workshop are difficult to maintain among participants as they move back into their "normal" environment with its own conditions, expectations, and commitments. Participants are not solely responsible for implementation of the new projects themselves. Instead, they may seek to involve new partners by again running the workshop process with a new project team and participants. Original participants may continue working with town administration and other formal institutions. They may give a training workshop to team leaders of a new project. They may also collaborate with participants of a collective learning process in an adjoining coastal neighborhood. Further recruitment of new participants will require new team building with the same diverse representation as in the original process.

As coastal resilience spans geographies greater than individual neighborhoods or zones of shared risk, means to communicate and coordinate action plans across multiple areas is also vital. Existing planning processes and instruments that are mandated by law at regular intervals such as the *Plan of Conservation of Development* (PoCD) may also benefit from the methods of the collective learning process. A PoCD may become a formal venue to integrate the results of multiple collective learning processes across multiple coastal neighborhoods and communities. As coastal resilience planning becomes a part of general planning and decision-making, the approach outlined here may create new opportunities for tackling complex, adaptive challenges as conditions change in the upcoming decades.

REFERENCES

[1] Heifetz, R A. 1994. *Leadership Without Easy Answers*. Cambridge, MA: Harvard University Press.
[2] Rittel, Horst W J, and Melvin M Webber. 1973. "Dilemmas in a General Theory of Planning." *Policy Sciences* 4 (2): 155–69. doi:10.1007/BF01405730.

[3] Heifetz, R A. 1994. *Leadership Without Easy Answers*. Cambridge, MA: Harvard University Press.
[4] Kegan, R, and L L Lahey. 2009. *Immunity to Change*. Cambridge, MA: Harvard Business Press.
[5] Brown, Valerie A, and Judith A Lambert. 2012. *Collective Learning for Transformational Change*. Routledge.
[6] Leiserowitz, A., Maibach, E., Roser-Renouf, C., Feinberg, G. & Howe, P. 2013. Global Warming's Six Americas, September 2012. Yale University and George Mason University. New Haven, CT: Yale Project on Climate Change Communication. http://environment.yale.edu/climate/publications/Six-Americas-September- 2012
[7] Brown, Valerie A, and Judith A Lambert. 2012. *Collective Learning for Transformational Change*. Routledge.
[8] *Ibid*.
[9] Mezirow, Jack. 1997. "Transformative Learning: Theory to Practice." *New Directions for Adult and Continuing Education* 1997 (July). San Francisco: Jossey-Bass: 5–12. doi:10.1002/ace.7401.
[10] Kegan, R. 2009. "What 'Form' Transforms? A Constructive-Developmental Approach to Transformative Learning." In *Contemporary Theories of Learning*, 35–52. New York: Routledge.
[11] *Part 2 – Example Application* is largely adopted from: Brown, Valerie A, and Judith A Lambert. 2012. *Collective Learning for Transformational Change*. Routledge. and: Kegan, R, and L L Lahey. 2009. *Immunity to Change*. Cambridge, MA: Harvard Business Press.